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THE MISHMI MISSION SURVEY DETACHMENT.

By CAPT. C. P. GUNTER, R.E.

REPORT FOR 1911–12.

Reproduced by the kind permission of COLONEL SIR S. G. BURRARD, K.C.S.I., F.R.S., R.E., *Surveyor-General of India, from the "Records of the Survey of India," Vol. IV.*, 1914.

ORDERS were issued for a Survey Detachment to accompany the Mishmi Political Mission which had been sanctioned by the Secretary of State to form part of a general scheme of operations along the North-East Frontier in connection with the Abor Expedition. The portion of the frontier allotted to the Mishmi Mission extended from the Yamne-Sesseri watershed on the west to the Luhit-Namkiu Divide on the east, containing the whole of the Mishmi Hills.

The detachment (Capt. C. P. Gunter, R.E., in charge, Lieut. H. T. Morshead, R.E., Mr. Abdul Hakk, K.S., Surveyor Alla Ditta, Sub-Assistant Surgeon Ishwari Persad Sharma, Ward Orderly Chamman Singh and 32 khalasis,—in January Surveyor Amar Singh with 4 khalasis joined the Nizamghat Column) was formed on September 20th and the various members joined in Calcutta or Gauhāti arriving in Kobo on the 8th October where the detachment had been ordered to proceed.

After spending 10 days at Kobo in pouring rain the detachment proceeded to Sadiyā, the headquarters of the mission. Here a halt of a fortnight was utilized in surveying the plains round Sadiyā, and on the 1st November the march to the hills *viâ* Tamei Mukh was commenced; but it was not until the 25th November that actual plane-tabling was started, by which time rations had been collected for the advance of the main column into the hills. Survey work was carried on independently of the movements of the main column, each plane-tabler being given a small escort so as to enable him to be free to move when he wished.

The main column returned to Sadiyā by the third week of February, 1912, and survey operations closed by the 5th of March.

The main column followed the old Mishmi path from Sadiyā to Tamei Mukh through the villages of Tashianliang and Salamgam and thence up the right bank of the Luhit as far as the Yepak River. The Chinese had planted a wooden boundary post at Menil Krai close to the Yepak River; beyond this the Mission did not go, but the survey was carried on as far as Samā Village about 20 miles further up the Luhit Valley.

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A small detachment had been left at Nizamghat and it was the intention of the Political Officer to try and find a way back to the Dibāng River from the Yepak across the mountains to the north and west, and join the Nizamghat column up the Dibāng; but the nature of the country made this impossible and the column returned to Sadiyā by the same road as it had come. A small detachment with a surveyor explored the Delei and Dou Valleys and separate escorts enabled the Ghalum, Lati, Lang, Tawa and Kharem Valleys to be surveyed. The surveyor with the Nizamghat column surveyed up the Dibāng as far as Idipo Village, some few miles beyond the point reached by Capt. Robertson in 1899—1900.

The country surveyed was of a most inhospitable and mountainous character; the main ranges, varying from 15,000 to 17,000 ft. in height, drop in a distance of 4 or 5 miles to the level of the main valley (about 4,000 ft.) at Samā. The slopes of the gorge through which the Luhit cuts its way are often nearly 40 degrees and the general fall of this river is over 40 ft. a mile in the distance of 90 miles from Samā Village to Tamei, where it debouches into the plains; it is practically a torrent for the whole of this distance.

North of Dong Village, the Dati falls a distance of 3,000 ft. in three cascades into the main river.

It is almost impossible to climb out of the Luhit Valley except up large streams such as the Ghalum, Lati, Delei, etc.; small streams such as the Namti, Yepak, Shet-ti, etc., are mountain torrents and quite impassable.

The mountain tops are a series of rock pillars, sometimes 200 or 300 ft. high, joined together by snow-covered ridges. The shape of the main ridges prevented any view being obtained of the Tibet highlands supposed to exist to the north. The greatest difficulty experienced by the Survey was caused by the rainy climate and continual mists and clouds which were prevalent even on the finest days. During the four months only 38 days were experienced without rain.

The plains between Sadiyā and the hills, and the first range of hills up to the Tiding River, are covered with dense forest, as are also the hills between the Kharem River and the Luhit River as far as the Hali River; from here eastwards the forest grows thinner and from Minzong onwards consists almost entirely of fir and rhododendron. Above 10,000 ft. there is very little forest growth, and the mountain tops appear to be entirely rock and precipice.

In January the snow line often came as low as 7,000 ft. for a few days at a time, but 10,000 ft. was usually the limit of snow.

A Miju Mishmi village consists usually of one or two long wooden houses built on piles; several families live in each house, they have dirty habits and are exceedingly poor. At first sight it appears wonderful that human beings can find a living at all in these wild

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mountains, but at the bottoms of the valleys where there is soil it is very fertile; crops of millet are also grown on hillside clearings. Up the Delei Valley the villages of Taroān Mishmis often have 20 to 30 houses, and they appear to be more prosperous and possess cattle and pigs.

The transport was entirely Nāgā coolies who were excellent in the low hills but proved quite useless above the snow line, and were not properly clothed to stand intense cold.

Triangulated points were carried as far as the Delei River watershed but the survey of the main valley beyond Minzong was carried out by means of a subtense-bar theodolite traverse, the azimuth being checked from snow peaks to the south.

The detachment completed 3,370 square miles of detail survey on the ¼-in. scale, 1,010 square miles of ¼-in. reconnaissance survey, 384 linear miles of 1-in. plane-table traverse, 22 linear miles of subtense-theodolite traverse and 21 linear miles of time and compass traverse. The triangulation fixed three new stations of observation and 18 intersected points besides three interpolated stations with the object of testing the plane-table work near Minzong; a small area round Wālong and the Yepak Camp was surveyed and mapped on the 2-in. scale.

The area surveyed has been provisionally mapped on the same scale in one sheet which includes also the former survey by Capt. C. L. Robertson, C.M.G., R.E., in 1899—1900, a survey of the Nam Dapha Valley by Ram Prasad who accompanied Capt. Pritchard in 1912, and the Sesseri Valley with new information as regards villages and streams compiled from the Nizamghat column report, 1912, the whole comprising 22 1-in. sheets falling in degree sheets 82P, 83M, 91D&H, 92A&E.

The map produced included 690 place names of which 370 were villages.

The principal places of interest fixed by the Survey were:—

(*a*). Tibetan villages of Samā, Kahao and Rimā.

(*b*). The Talok Dakhru 11,000 ft., the pass on the Luhit-Nam Tamai Divide over which an easy track leads from the Luhit Valley to the Nam Tamai.

(*c*). The Kong Dzong Pass leading from the Ghalum Valley to Hkamti Long.

(*d*). The G'lei Dakhru 12,820 ft. over which a road leads from the Delei Valley into the Rong Thod Chu.

(*e*). The Kue Dakhru about 14,000 ft. through which a road connects the Delei Valley with the Ithun Valley.

(*f*). The trade route used by the Mijus leading from Wadong in the Luhit Valley across the Lang Valley joining up with the pilgrim road from Paras Ram Kund to Chongkham in Hkamti.

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Other places of interest were :—

(*g*). The Dati Falls where a stream falls 3,000 ft. in three cascades into the Luhit River.

(*h*). Tilam opposite Dong Village where there is a spring of clear hot water.

(*i*). Twin peaks Kakro and Chhichhadia Heights 17,150 ft. and 17,172 ft., two huge rock pinnacles between which a track is said to lead connecting the Dou Valley with the Luhit down the Tho Chu.

(*j*). Glo Hawei, a small lake about ½ mile long and ¼ mile wide in the Kharem Valley at an altitude of 3,890 ft.

The general health of the detachment was good but the weak ones amongst the khalasis soon felt the strain of hill climbing and remained behind at various intermediate posts.

REPORT FOR 1912-13.

On the 12th September, 1912, the Surveyor-General issued orders for me to proceed to Calcutta and take charge of the detachment (Capt. C. P. Gunter, R.E., in charge, Lieut. H. T. Morshead, R.E., Mr. Abdul Hakk, K.S., Surveyor Shaikh Muhammad Salik, Surveyor Sheo Lal, 28 khalasis (Hazaribagh). Sub-Assistant Surgeon Zulfikar Hyder and a Ward orderly joined later in Sadiyā) which would be detailed to carry on survey operations in continuation of last year's work in the Mishmi Hills : all arrangements for the field season to be made pending final sanction from the Government of India. Telegraphic orders were issued on the 6th October to proceed without delay with the detachment to Assam. On the 10th October the whole detachment as detailed above left Calcutta with all the necessary equipment, instruments, and data. On the 13th October we arrived in Sadiyā ; it took the whole of the 14th to get the kit across the Brahmaputra, and on the 15th the camp was pitched and instruments, etc., distributed.

The programme of work formulated by the Government of India for the detachment was as follows :—

(*a*). Surveys to be made of the Dibāng Valley in continuation of the work done last season : of the Dri River to its source : of all the inhabited valleys leading into either the Dri or Dibāng Rivers : and of the Sesseri Valley to connect with the Mishmi and Abor surveys of last season.

(*b*). In order to give the Survey officers a clear appreciation of the points regarding which the acquisition of geographical knowledge is of the first importance, the following detailed instructions were communicated :—

To discover the course of the Dibāng River, and whether the Nagong Chu is one of its tributaries. To fix the main

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range of the Himālayas, north of the Dibāng River basin and the subsidiary ranges in the basin, particularly with reference to their junction with the range bordering the Taroān and Miju Mishmi country on the north-east (*i.e.*, the watershed between the Rong Thod Chu and the Delei).

As the extent of the Dibāng Valley was entirely unknown and the whole country unexplored, it was impossible to know what area we might be called upon to survey. The Government of India had sanctioned a party of two Imperial officers and two surveyors, but in order to be in a better position to complete an area of larger extent than expected and knowing that one surveyor can only deal with one valley at a time in the Mishmi Hills I asked for the services of a third surveyor and this was granted.

On arrival at Sadiyā we found that no orders had yet been issued by the civil authorities for the formation of the exploration party and that Mr. Dundas, who was to have control of the two exploration parties in the Abor and Mishmi country, had not yet received sanction to proceed with his arrangements. This was a severe blow to us as we realized that at the earliest the expedition could not be ready to leave Nizamghat, the advanced base, until the end of November. So in spite of the experience gained last year and the reports of all officers, in which it was urged that any operations in the Mishmi country should commence as early as possible in October, we were actually going to start at least a month later this year than we did last.

The work was distributed as follows :—

(*a*). Lieut. Morshead to undertake all the triangulation of as much of the area as was possible for one man to do.

Capt. Gunter to do the plane-tabling of the main valley and other valleys if necessary to the north.

Mr. Abdul Hakk the plane-tabling of the Sesseri Valley, foothills west of the Dibāng River and the Ahui River.

Surveyor Shaikh Muhammad Salik to accompany Lieut. Morshead and help in clearing, etc., the first three hill stations, and then do the plane-tabling of the side valleys west of the Dibāng River. Surveyor Sheo Lal to carry out a large scale plan survey of Sadiyā itself, which was specially asked for by the Political Officer, and then the plane-tabling of the side valleys east of the Dibāng River.

Both Capt. Gunter and Mr. Abdul Hakk were to carry 3-in. theodolites in case they might be in a position to help with triangulation.

(*b*). It was determined to make use of the present fine weather to push on at once with triangulation from the nearer range of hills, north of Sadiyā, using local labour. On

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October 18th Lieut. Morshead, Mr. Abdul Hakk and Surveyor Shaikh Muhammad Salik left Sadiyā with bullock carts, accompanied by Mr. Ballantine, the Assistant Political Officer, *en route* for Nizamghat. The political authorities had issued orders for local labour from the nearer villages to be collected and be ready to go into the foothills. We foresaw that the success of the operations would depend almost entirely on the triangulation which Lieut. Morshead would be able to accomplish during the fine weather in October and November from three stations on the first high range, so that every endeavour was made to enlist the sympathy of the political officers to help us in getting local labour to enable us to start work at once. The political officers were most anxious to push on our work and did everything they could; but unfortunately Mr. Ballantine, the Assistant Political Officer, was called away from Nizamghat at a most critical moment and in consequence the Mishmi coolies did not turn up to take Lieut. Morshead and party into the hills.

The road to Nizamghat was found to be very much overgrown with jungle and the party did not arrive there until the 23rd October, taking six instead of three days. On October 26th Abor coolies from Dambuk Village arrived to accompany Mr. Abdul Hakk and enable him to survey the foothills round Dambuk.

(*c*). *Dambuk Party.*—This party, consisting of Mr. Abdul Hakk and 25 Military Police sepoys under a Subadar, crossed the Dibāng in boats; during this operation one sepoy was drowned and several rifles lost owing to the upsetting of a boat, so it was decided not to continue the march but return to Nizamghat. On November 1st the same party again crossed the Dibāng and marched to Dambuk, 40 Abor coolies meeting them at the river opposite Nizamghat. Mr. Abdul Hakk continued plane-tabling along the foothills, on the 3rd he reached the Sesseri River, on the 4th Memosipo Village, and returned to Nizamghat on the 7th November. During this week he completed 300 square miles of new country and fixed the position of several large Abor villages which had not been visited by any Government official for many years. Dambuk proved to be a very large and prosperous village of 400 houses, and the other Abor villages were, Memosipo 100 houses and Siluk 200 houses. Although these Abors were friendly and did not actually interfere with the work, they did not put themselves out in any

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way to help Mr. Abdul Hakk, and it was only the presence of a strong escort which persuaded them to work for very high wages. Plane-tabling of the valley and lower hills was completed up to the Siku-Sibya watershed and a junction made with the Abor Survey.

It had been settled that the triangulation should be started from Sajuba Hill (Sita h. s. height 11,649 ft.) east of the Mahu Pass and a lower hill called Breliangun (9,809 ft.) west of the pass. A few Mishmis having turned up on the 28th October Shaikh Muhammad Salik started clearing the road to the Mahu Pass but it was not until November 6th that sufficient Mishmis arrived to take on Lieut. Morshead who started observing from Breliangun h. s. on the 10th and from Sita h. s. on the 13th. Bad weather had now commenced, and on the 19th snowstorms necessitated a retirement from the bivouac at 10,250 ft. below Sita h. s., causing the death of one Mishmi by being frozen and the abandonment of further observations. This was a very unfortunate beginning for the triangulation and was brought about entirely through the Mishmis not coming into Nizamghat when ordered on the 25th October. On the death of the man at Sita h. s. every Mishmi bolted and left Lieut. Morshead and party to get back to Nizamghat as best they could; this was accomplished after much difficulty by short marches and continually returning for kit left behind at each stage. The result of the observations from these two stations was of great interest as not only were many points fixed on the northern watershed of the Dibāng Basin but also Pemakoi Mountain and some new peaks on the same range; and we now had a rough idea as to how far the Dibāng Basin extended northwards.

At the beginning of November a company of Sappers and Miners and Pioneers arrived in Sadiyā and at once went off to Nizamghat to cut a road over the Maya Cliff, an obstacle which blocked the approach up the Dibāng Gorge some 4 miles north of Nizamghat. After making 10 miles of mule road and bridging the Ahun and Ahsun Rivers the Sappers and Pioneers were sent up the Luhit Valley. On the 20th the first batch of coolies, 50 in number, arrived in Sadiyā, but it was not until the first week of December that the coolie transport was complete and the whole force consisting of Major C. Bliss, Commanding Escort, Capt. G. A. Nevill, Political Officer, Capt. F. M. Bailey, Intelligence Officer, Capt. Kennedy, Medical Officer, 4 British Officers, 350 Military Police and about 1,100 coolies assembled at Nizamghat. On November 28th, after completing and handing over to the Political Officer the 6-in. plan survey of Sadiyā, I left Sadiyā with Surveyor Sheo Lal for Nizamghat, moving with bullock-cart transport. On December 2nd, Lieut. Morshead left Nizamghat for Ede h. s. (6,340 ft.), on the west bank of the Dibāng, and after completing his observations returned to Nizamghat on the 8th.

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On December 4th Mr. Abdul Hakk accompanied the Sesseri Column which left Nizamghat for the survey of the Sesseri Valley under Capt. F. M. Bailey, Political Department. About 100 Abor coolies came to Nizamghat to carry the rations of the party as far as Angatsi Village, and this was a great help as it enabled the party to advance by full marches for three days. On the 5th the camp on the Sesseri, east of Dibāng, was reached; on the 6th camp was pitched on an island in the middle of the river bed just above the junction of the Egadi stream, the next day Angatsi was reached after marching along the right bank of the river and crossing over a couple of miles south of Angatsi; beyond Angatsi the meeting daily convoy was established and the Abor coolies returned to their homes. On the 9th Ihili was reached. On the 10th the march was continued up the Siku River, the last fixing up the Siku being made on the 12th in some fields belonging to the Damro Abors, at a height of 3,840 ft. From here a track leads over the Baisha Pass to Damro which can be reached in one march. Returning on the 13th Ihili was reached and on the 14th the party marched up the Sesseri to Ewalin, reaching Ardai Village on the 15th; here a halt of one day was made to enable Mr. Abdul Hakk to climb a hill 8,643 ft. and sketch in the head-waters. From Ardai Village two tracks lead over the Sesseri-Ahui watershed into the Ahui Valley at an elevation of 9,480 ft. and 8,200 ft. and Capt. Bailey was anxious to continue the advance over one of these passes into the Ahui, but as it was rumoured that the Ahui Mishmis were not friendly and as they had never been visited before, the force at Capt. Bailey's disposal at the head of his line was deemed not sufficiently strong, especially as the main column could not possibly reach the Ahui River in time to act as a containing force and cover his advance down that valley. On the 19th December therefore the party commenced the retirement, reaching Angatsi on the 19th. On the 20th Capt. Bailey followed the main valley route *viâ* Dambuk to Nizamghat while Mr. Abdul Hakk followed the high level track to Katopu reaching there on the 20th; here he remained one day owing to bad weather in order to complete his work, and on the 22nd returned to Nizamghat *viâ* Simi Village, thus bringing to a close a very successful little expedition. The Mishmis up the Sesseri were very friendly and anxious to help in every way; they appeared to be quite overawed by the Abors of Dambuk and could do nothing without their permission.

Shaikh Muhammad Salik who had already cut in points on distant ranges on my board from Sita h. s., Breliangun h. s., and Ede h. s. left Nizamghat on December 4th and resurveyed the main Dibāng Valley as far as Kronli Village. On December 9th Lieut. Morshead accompanied by Capt. Nicolay with an escort proceeded up the Dibāng River and crossing it at Kronli on the 12th climbed to Arundi h. s. (6,283 ft.) completing his observations by the 16th.

On December 17th I left Nizamghat with Surveyor Sheo Lal

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and marched up the Dibāng taking over my board from Shaikh Muhammad Salik at Kronli on the 21st and started plane-tabling up the main valley. By December 27th the whole detachment was at Imbolin Village ready to carry on work ahead. We had now got to the furthest point reached by the party that explored this valley last year and there was much speculation as to what the country was like on ahead, whether Mishmis would be friendly, etc., as no European had as yet seen the country north of the Ichi River and the Mishmis south of this river professed absolute ignorance of what there was north of it. In the meanwhile the supply of rations had completely broken down and it was decided that no forward movement of the main column could be undertaken for some time to come. Major Bliss, commanding the force, however, was able to arrange for the feeding of small advanced parties, if they moved slowly, so as to enable the triangulation to be carried on without interruption. All coolies except those necessary for Capt. Morshead and a few to enable my own party with two other British officers and some 30 sepoys to advance, were sent back with Mr. Abdul Hakk and the two surveyors to Nizamghat. By using Mishmi labour it was found possible to advance with this small party.

Capt. Nevill, Political Officer, with Capt. Nicolay and some 30 sepoys, crossed the Ichi River on December 30th and established an advance post at Angolin Village. After completing his observations at Ehundi Hills (7,364 ft.) just above Imbolin, Capt. Morshead moved forward on the 3rd January and reached his 9,000-ft. camp on Achi Hill on the 7th; seven days were spent clearing the station. On the 5th January I managed to collect some Mishmi coolies and by their help and by using the small meeting convoy which had been established, I left Imbolin and reached Angolin on the 7th. On the 10th I moved up Achi Hill and with Capt. Morshead got a good view of the Matun, Dri and Tangon Valleys on ahead of us.

The days spent on Achi Hill were full of interest as we were fixing on the map of the world rivers, peaks and valleys which had not been seen or even heard of by Europeans; the views too were very fine and impressed on us the utter wildness of the country. Returning to Angolin on the 14th, I joined the advanced party with Capt. Nicolay, and by the help of Mishmi coolies reached Etalin Village, at the junction of the Dri and Tangon Rivers, on the 17th. Capt. Morshead completed his observations at both the Achi stations (10,433 ft. and 9,560 ft.) by the 18th and joined us at Etalin on the 20th of January. In order to allow of rations being collected at Etalin, it was necessary for the advanced party to make a halt here of a fortnight. Capt. Morshead was seedy and required a rest and also had a week's computation work to do, so I took his coolies and started up the Tangon River on the 21st. The wet weather had now commenced in earnest and from this time onwards there were very few days on which one could set up the plane-table without

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having to protect it by means of a waterproof sheet stretched tent-wise on poles. I went three marches up the Tangon and returned to Etalin on the 26th. All the Mishmis up this river appeared very friendly and anxious to please, but the curiosity of some of the ladies anxious to get their first view of a European was rather trying, especially when one was struggling to bathe and dress in a 30-lb. tent. On January 30th, Major Bliss and the other officers having arrived at Etalin, a conference was held to settle the future programme. The conclusions come to were :—

"Continue the main advance up the Dri Valley as far as the Matun confluence and thence follow the Matun Valley; the main column under Major Bliss to complete this valley and its tributaries whilst another column under Capt. Nicolay was to go up the Emra Valley. It was found that there were not enough coolies to maintain more than two survey parties and a triangulation party working simultaneously. I was to continue the plane-tabling up the Dri and Matun whilst Mr. Abdul Hakk accompanied the Emra column; Surveyor Sheo Lal to accompany me in case it might be found possible to survey some side valleys during the advance, while Shaikh Muhammad Salik remained at Nizamghat until it would be possible to free coolies from the main line and enable another side valley to be explored."

During January a regular meeting system of convoys had been arranged from Nizamghat onward and rations were now being rapidly collected at Etalin for the main advance and at Angolin for the Emra party. On February 1st Capt. Morshead left Etalin for Iliyi Hills (9,928 ft.) and completing observations on the 5th went by a short cut to Yuron Village on the 6th.

On the 5th I accompanied the advanced party of the main column up the Dri; the going was slow as the road was very bad, progress being only some 5 or 6 miles a day, and we arrived at Yuron on the 9th, having established a meeting convoy system with Etalin. On the 11th Capt. Morshead left Yuron for Tondondi Hills (9,627 ft.) and on the 14th I accompanied the advanced party to Ilupu Village near the junction of the Dri and Matun; on the 15th the Emra party having collected sufficient supplies started up the Emra Valley crossing the Dri River by a Mishmi suspension bridge at Aprunyi Village. At Ilupu it was necessary to halt a week to enable supplies to come up and also to await the main body of the escort which had now been ordered up from Nizamghat. As no information about the country up the Dri could be obtained except that there were Tibetan villages there, peopled by Pohs, who were very fierce and went for every one on sight with a drawn sword, the Officer Commanding the Force did not consider it safe to proceed without a large escort; during the halt I moved about with a small escort and managed to survey a large tract of country and cut in many useful points on ahead. The country here was mostly cleared of jungle

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up to 7,000 ft. elevation along main spurs which greatly simplified plane-tabling. On Tondondi Hills Capt. Morshead had a bad time as it snowed almost continuously, but one fine day enabled him to complete a large portion of the observations he wished to take and so, as the main advance had commenced, he thought it best not to waste any more time on this hill, and so left it on the 26th February, following up the main column which he joined at Mipi Post on the 1st of March.

On February 19th the main body of the escort arrived, and an advance was commenced on the 20th and continued by short marches up the Matun Valley; I joined the main column on the 23rd and moved with it. On the 26th we reached the Imu Stream and from a high spur obtained a view of the Tibetan village of Mipi, a very small insignificant hamlet, it appeared, and so it was arranged to cross the Matun next day and visit the village. The main column crossed the Matun on the 27th by means of a temporary footbridge (made by the Mishmis who had accompanied us) and on the 28th Mipi Village was reconnoitred and found to contain only harmless Kambars and not the fierce Pohs that the Mishmis had given us to understand were there; on March 1st a post was established at the junction of the Matun and Andra Rivers, just beyond Mipi Village. Here a week's halt was necessary to collect rations for a further advance; a few fine days here enabled me to do a lot of plane-tabling from several high fixings, and Capt. Morshead cleared and observed from a station in the vicinity, but unfortunately the weather did not allow him to see any new snow peaks, nor could he get a view of the main range to the north up the Adzon River nor up the Andra. During the halt at Mipi Capt. Bailey, who is a good Tibetan scholar, managed to extract a good deal of useful information from the Tibetans about the Tsan-po and country north of the Andra and Adzon watershed, and it was here that the plan took shape of his crossing over into the Chimdru Valley with Capt. Morshead to unravel the mystery of the "falls" and course of the Tsan-po between Chamkar and Rinchengpung. It was interesting to discover that the name Pemakoi (Tibetan for promised land) which has been entered haphazard over different areas of the old maps of this part of the world, really refers to this valley of the Matun. Seven years ago some thousand Tibetans from Chimdru, on the strength of a prophecy that this was their promised land, came over the Andra and Yonggyap Passes into Mipi and turned out the few Mishmis whom they found in the Matun Valley. It did not take them long however to discover that this was not the land flowing with milk and honey that they expected and that the country could not maintain them. They had already left many dead along both the Andra and Yonggyap routes. Apparently all who could soon made up their minds to quit and return to Tibet, which they did by way of the Yonggyap, Dri and Jairu Passes, leaving many

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hundred dead along the various routes. A small party of 80 souls who were either too old or too feeble to travel, remained behind and with them a few able-bodied men; these now form the community of 60 who live in Mipi. The weather now was quite hopeless and the snow line had descended to 6,000 ft. so that further triangulation was abandoned; fortunately I had managed, during the advance up the Matun, to fix a few points up the Andra Valley, sufficient to enable plane-tabling to be continued up that river. A conference was now held and it was settled that as the Tibetans were found to be such a small community and so friendly it was deemed safe to diminish the escort with the main column and so enable a party to proceed up the Tangon Valley earlier than was expected. News from the Emra party had also reached us that they would be back at Etalin by the middle of March, it was therefore arranged that this same party should on completing the Emra work proceed up the Tangon Valley; in the meanwhile rations were to be collected at Etalin for this trip. The main column was to split up into two parties, one to go up the Andra and one up the Adzon and continue roadmaking simultaneously. The points of importance to be fixed in this neighbourhood were the Andra and Yonggyap Passes and the survey of the Andra, Yonggyap and Adzon Rivers; Surveyor Shaikh Muhammad Salik was therefore called up to help me, and Surveyor Sheo Lal was to go down the line to Etalin and undertake the survey of the Tangon Valley, while Mr. Abdul Hakk with a 3-in. theodolite would accompany the Tangon party and extend the triangulation in that direction.

On the 5th March Capt. Hensley started up the Andra Valley with his party roadmaking and a few days later the Adzon (Matun) party left Mipi roadmaking and laying out posts up the Adzon Valley. On the 7th I proceeded up the Andra plane-tabling and was followed a few days later by Capt. Morshead and Capt. Bailey, as soon as the former had done all he could from Mipi h. s. (7,056 ft.). The advance up the Andra was very slow and difficult owing to incessant rain and snow and bad ground, only 3 or 4 miles a day being the progress made. On the 10th we got as far as it was possible for the Nāgā coolies to go and were snowed up in this camp at 7,000 ft. altitude for five days. The last fixing up this valley was made at an elevation of about 9,000 ft. at a distance of about 130 miles from Nizamghat. It was intended that Capts. Bailey and Morshead should make a dash for the Andra Pass from the last post and fix it by means of a time and compass traverse, but the snowfall was so heavy that it was impossible for them to move. On the 16th the return journey was commenced in snow and sleet. Capt. Bailey, however, instead of returning, moved up the Andra a few miles and found shelter in a cave where he remained several days waiting for the snow to stop; he eventually managed to get in another few miles of the track to the Andra Pass and this proved most useful as it

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dispelled all doubt as to which valley the path actually followed. This trip up the Andra was the most mournful of the whole expedition, for, in addition to the disgusting weather conditions, we were continually coming across the remnants of the cooking pots, clothes and dried bones of the Tibetans who had died in this valley from exhaustion and starvation on their way from Chimdru to Mipi. On the 19th March we found that the road up the Adzon had been made for some 20 miles and that all was ready for our immediate move up there.

Surveyor Shaikh Muhammad Salik was ready here, and on the 21st March the party under Major Bliss proceeded up the Adzon while Capt. Hensley went down the line to the Dri-Matun junction to make arrangements for the rations and escort necessary for the trip up the Dri River.

Owing to the excellent road made by Lieut. Lane the marching up the Adzon was very easy and a great relief after the Andra experience. Shaikh Muhammad Salik went up the Yonggyap Valley to try and locate the Yonggyap Pass, but in this he failed as he was driven back, after reaching an altitude of 8,000 ft., by heavy snow. Capt. Morshead accompanied me with the idea of running a theodolite traverse up the narrow gorge of the Adzon; fixings were not to be expected as it was absolutely impossible to climb any of the hills on either side. The dense jungle however made such a traverse quite out of the question and so I had to have recourse to a range-finder traverse instead. Capt. Morshead returned to Mipi on the 27th on his way to Agidzu h. s. (10,426 ft.) with a view to fixing more points up the Dri Valley. By the 29th of March I had continued traversing as far as the deep snow and precipitous nature of the river bed would allow me to go, and after making a last fixing at 8,850 ft. in the stream at a distance of 141 miles from Nizamghat started the return journey. Luckily when at the lake on the way back we had a fine day, all the snow peaks showed up and enabled me to cut in a lot of important details. On March 29th Shaikh Muhammad Salik returned to Mipi on his way to the Elon Valley to put in a portion of the Mipi-Emra Road not seen by me. On the 2nd April the whole party had returned to Mipi and on the 4th the retirement commenced.

It is now convenient to turn to the Emra party and their fortunes. Leaving Aprunyi on the 16th February the party under Capt. Nicolay moved slowly up the valley by short marches, cutting their way through the jungle along the Mishmi path and roadmaking as they went. They reached as far as one march beyond Asonli, the furthest village up the valley and returned to Etalin post on the 18th March. Continuous rain and snow made progress very difficult and Mr. Abdul Hakk was able to survey only the actual valley itself as far as he had gone; the sketching in of the snow ranges at its head was impossible owing to continuous bad weather. On account

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of continuous rain survey work was impossible until the 18th, so that Capt. Nicolay was able to get ahead of Mr. Abdul Hakk and establish two posts. On the 20th of February Mr. Abdul Hakk after completing the work in the valley as far as Aihini climbed to 6,500 ft. to try and cut in the distant main ranges; he then continued plane-tabling under very unfavourable weather conditions until the 28th, catching up the roadmaking party on the 21st. On February 28th a 9,000-ft. hill was ascended and a view of the watershed west of the Emra was obtained. The last fixing up this valley in the river bed was at 4,459 ft. at the Eken River on the 4th of March at a distance of about 100 miles from Nizamghat. The snow line now descended to 5,000 ft. and it was snowing so continuously that it was decided to abandon any further advance up the valley and, if necessary, sketch in the head-waters of the Emra from the high range at Deshindi h. s. and Ayandi Peak after the snow had diminished in May.

The Mishmis up this valley proved to be friendly but all the usual military precautions had to be taken throughout. The village of Ahalin was formerly in the Matun Valley, but the Tibetans on their arrival at Mipi some seven years previously drove them out. The inhabitants of the Emra Valley appear to be the only Mishmis who have established trading relations with the Mipi Tibetans. They had no communication with the Dihāng people over the pass at the head of their valley, the last attempt made by them in this direction resulting in the annihilation of the whole party except one man.

On March 21st a party under Capt. Nicolay with Capt. Nevill, Political Officer, left Etalin Post to explore the Tangon River. Mr. Abdul Hakk and Surveyor Sheo Lal accompanied it, the former to extend the triangulation and give points to the latter to carry on plane-tabling as far up the valley as possible, both up the Tangon and Edza Rivers. The important points to be fixed were the Kaya Pass, the main watershed of the two rivers, and to ascertain whether the Trem River, the head-waters of which were seen by Mr. Abdul Hakk last year, flowed into the Edza River or eastwards into the Rong Thod Chu. On the 23rd March, Mr. Abdul Hakk went up Anoya h. s. (6,240-ft.) completing his observations on the 24th, and Surveyor Sheo Lal started plane-tabling. On the 26th March they started the climb to Ahongon h. s. (8,006 ft.) completing observations on the 28th. On the 1st April both men went up Apongon h. s. (8,625 ft.) and finished observations on the following day. On the 4th Chiyangon h. s. (10,284 ft.) was cleared and observations completed on the 5th; the camp was pitched at 10,000-ft. altitude in rhododendron and bamboo jungle, and melted snow was the only water available; two nights were spent in this camp. Continuing plane-tabling up the valley both officers worked together and visited all stations at the same time so that the theodolite observations could be utilized at once by the plane-tabler. On April 9th Ekingon h. s.

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(11,532 ft.) was visited and observations completed; the camp on this hill where two nights were spent was at 10,500 ft. and water was obtained by melting snow in cooking pots. The pine and spruce forest reached as far as 8,500 ft., and above this to the very tops of the ranges bamboo and rhododendron were met with. On the 16th Marungon h. s. (9,926 ft.) was reached, the observations being completed in one day. The 19th April found them on Atuniyangon h.s. (11,354 ft.) where observations were again completed in one day; this was the furthest station up the Tangon River, the snow line all this time being at about 9,000-ft. altitude; the camp on this hill was at 10,000 ft. in spruce and rhododendron forest and again the only water available was from melted snow. In spite of all the climbing done no view had yet been obtained of the main watershed nor had the end of the valley been seen. The weather all this time was very bad and continued rain and mist made survey operations almost impossible. On account of the bad weather Mr. Abdul Hakk decided to turn back and complete the Edza Valley, with the idea of returning to the Tangon in May when there would be more chance of getting fine weather and the snow line would have receded, making the ascent of higher peaks possible. On the 20th April the last fixing up the Tangon was made at 9,000 ft. in river bed at a distance of about 130 miles from Nizamghat; here the party was turned back by heavy snow and the return journey commenced on the 21st. On April 27th Tangon Hill was ascended and observations taken at the lower station (9,482 ft.). On the 29th the upper station (12,913 ft.) was visited and observations completed on the 30th; the camp here was maintained at 12,500 ft. in thick spruce and small bamboo forest, this forest continuing right up to the top of the peak where large trees were found; the only water available was from melted snow and altogether four nights were spent in this camp. From this hill a good view of the Edza main watershed and head-waters was obtained and also the whole of the Ithun-Edza Divide was seen; the Makhri and Ipi head-waters were also seen from this station, but it was very disappointing to find that no view could be got of the Tangon head-waters or of the Kaya Pass. Leaving here on the 1st May, Kado, the last post up the Edza, was reached on the 2nd at an altitude of 7,800 ft. On the 3rd the climb up Kelingon h. s. (13,773 ft.) was commenced and camp was pitched at 10,200 ft., on the 4th camp was moved up to 12,500 ft. and from here work was carried on. From this station the main watershed of the Tangon was visible and one ray was also obtained to the Kaya Pass. Wishing to get another ray to the Kaya Pass and a still better view of the main ranges it was determined to climb another higher hill to the north. On the 8th this higher peak was climbed and proved to be 15,073 ft. Unfortunately Sheo Lal had a bad fall on the summit of this peak and dislocated his thumb, he was obliged therefore to return to the 12,500-ft. camp. Mr. Abdul Hakk nothing daunted

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pitched his camp on a convenient piece of ground just 100 ft. below the summit and remained there one night. In spite of the exposed situation in deep snow and the intense cold the Ghurka coolies were prevailed upon, mostly through Mr. Abdul Hakk's good example, to remain at that high altitude and enable the necessary observations to be made. Mr. Abdul Hakk had taken over Sheo Lal's plane-table and cut in the main range at the head of the Tangon and confirmed the position of the Kaya Pass. Unfortunately the peaks to which rays had been taken from Kelingon h. s. (13,773 ft.) were never seen from the 15,073-ft. station owing to clouds which most annoyingly clung to them. On the second day so many coolies and khalasis were suffering from snow-blindness and frostbite that it was found absolutely necessary to go down the hill as fast as possible to have the sick men attended to. There was no water or wood at the top camp, the snow was melted and wood had to be brought up from the 12,500-ft. camp both for cooking purposes and for building shelters. Most unfortunately, owing to the main bridge over the Ithun River having been washed away, all men were on short rations and this exposure to cold and damp at such high elevations must have been most trying, and the greatest credit is due to Mr. Abdul Hakk and the surveyor for their courage and determination to complete their work in spite of the greatest hardships. On returning to Kado Camp on the 11th May the whole party commenced the retirement to Nizamghat, a distance of 110 miles, where they arrived on the 23rd May. Here a halt of six days was necessitated by a lack of transport. On the 29th they started for Sadiyā where they arrived on the 31st May.

We now return to the main column which had left Mipi on the 4th April and was retiring down the Matun. On the 7th I left the column at Maron Camp and cut across the downs to Akolin Village on the left bank of the Dri where Capt. Hensley had collected his force and rations ready for the exploration of the Dri River, which was crossed by a Mishmi cane suspension bridge. The rest of the column retired to Angolin Post and here under Major Bliss made arrangements for the exploration of the Ahui River. On the 9th April the Dri party under Capt. Hensley commenced the march up this valley. Surveyor Shaikh Muhammad Salik accompanied us as far as the Ange River where he left us on the 10th April for the survey of its valley and tributaries. He had with him a small escort of 3 sepoys and 18 coolies and managed to penetrate two marches up the gorge of this very wild and precipitous valley; continual bad weather hampered plane-tabling and it was not until the 21st April that he completed his work, comprising 200 square miles of precipitous mountain sides and snow ranges, and started down the line to Etalin Post with a view to joining the Ahui party.

We continued our march up the Dri Valley, crossing the Ange River by a Mishmi suspension bridge, and by moving half marches established a meeting convoy system as we advanced, large enough

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to carry one day's supplies for the whole party. On April 11th we passed Dembuen, the last village up this valley, and from here managed to obtain a couple of Mishmi guides to show us the way to the Aguia Pass reported to be at the head of the valley. The important work to be accomplished was the fixing of this Aguia Pass and the main watershed at the head of the Dri and its tributaries. Up to Dembuen the marching had been quite easy along flat ground close to the river bank, but from here onwards the jungle became very thick and necessitated much labour in clearing even a 2-ft. track. The valley contracted to a gorge with a few hundred yards of flat ground on each side of the river flanked by precipices rising straight up to a height of 2,000 ft. to 4,000 ft. At the commencement of the march on the 11th I made my last reliable fixing (by resection from triangulated points) close to the village of Acheshon at a height of about 5,500 ft., and from here onwards the survey of the valley was carried on by means of a range-finder plane-table traverse, checked at intervals by resection from previously fixed points. The gorge for 40 miles was so restricted and shut in by precipices on both sides that it was found impossible to climb out of the valley anywhere until the river bed had attained an altitude of nearly 10,000 ft.; the several side streams flowing into the main gorge were a very fine sight as they were in full flood and leapt the 3,000-ft. wall of rock in three or four magnificent cascades, falling on to the narrow flats on the river bank with a tremendous noise. The last camp up the valley at the junction of the Jairu Stream, nearly 8,000-ft. altitude, was reached on 19th April in pouring rain; the weather throughout had been hopeless, continuous rain day after day, but luckily it cleared on the 21st and so I followed up the river bed for about 4 miles and made a last fixing at a height of just under 10,000 ft. near the river bank, on the snout of a snow avalanche and at a distance of 142 miles from Nizamghat. In a distance of 1½ miles the river had risen from 7,500 ft. to 9,500 ft. in a series of cascades and falls. A very fine view was obtained of the Aguia Pass and head-waters of the Dri, and as deep soft snow made further progress impossible, after sketching as much as was visible, I returned to camp. The next day the rain came down again and it was decided to retire from this inhospitable spot and leave it free for the "Takin" to wander about in at their leisure. The Mishmi guide informed us that there was a track leading to Chimdru up the Jairu Stream, but we found no signs of it. On the track up the Dri just opposite the junction of the Jairu we found a palisade of pine logs with loopholes carefully cut; the Mishmi told us that this was constructed a few years back to protect Mishmis, going along the Aguia Pass track, from the attacks of Tibetans who used to frequent the Jairu Valley. Capt. Morshead who had reached Agidzu h. s. (10,425 ft.) on the 15th April took five days to clear the hilltop, being continually interrupted

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by snowstorms. The view from this station was very disappointing as none of the peaks at the head of the Dri, which he was specially anxious to fix, were visible. He left Agidzu on the 12th and marched to Acolin Post, meeting us at a camp beyond Dembuen Village on the 15th. Here we arranged that the best thing for him to do was to return to Yuron Post and from there take rations, etc., for a prolonged stay on the range where he made the stations of Deshindi and Karundi; this we thought would be favourably situated for a view not only up the Emra Valley but also to the head-waters of the Andra, Adzon and Dri Rivers. We also settled that after completing observations at Deshindi h. s. he would proceed to Mipi where Capt. Bailey would be waiting for him prior to their starting for their exploration into Tibet over the Andra or Yonggyap Pass and ultimate visit to the Tsan-po Falls and return to Sudia *viâ* Tawang. On the 18th he camped with Capt. Bailey on the right bank of the Dri at Epalin Village, having crossed by a Mishmi suspension bridge, and on the 21st camped at 8,400 ft. close to the hill where he was going to make Karundi h. s., while Capt. Bailey marched up the Matun Valley to Mipi Village. On the 22nd April he cleared Karundi h. s. (11,267 ft.) and on the 23rd cleared and erected a pole on Deshindi h. s. (12,027 ft.). Continual and heavy snowstorms interfered with work and it was not until the 7th May that he managed to take a round of angles from Karundi h. s. In the meanwhile I had come down the line with Capt. Hensley's party to Yuron Post which we reached on the 27th April. Here Capt. Hensley halted in order to make arrangements for the supply of rations up at our Karundi hill camp. On the 28th I crossed the Dri by the Epalin Bridge and reached Capt. Morshead's 9,000-ft. camp on the 29th and did some work from Karundi h. s. Both Deshindi and Karundi were clear hilltops of pure snow some 12 ft. deep and it was impossible to camp higher than 9,000 ft. owing to the continuous snowstorms and violent wind. Heavy rain and snow kept us imprisoned in our tents for six days when it cleared a little on the 6th enabling me to do some useful work in the lower portions of the Emra Valley not visited or seen by Mr. Abdul Hakk. On the 7th snowpeaks were visible up to 7 a.m. and a few theodolite observations were taken from Karundi. The 8th was a fine clear morning and we went up Deshindi h. s., but clouds hid all snow peaks by 8 a.m. and as it was a 3,000-ft. climb over snow the whole way, there was not much time for observations as one could not start before daylight. On the way up we had a fine view of Pemakoi and neighbouring peaks, but by the time we reached the station the whole Pemakoi Range was hidden in cloud. We had very bad luck in that the peaks that were visible from Karundi were just the ones that were in cloud when we visited Deshindi and *vice versâ*, and in consequence we failed to fix the few magnificent snow peaks of which

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we had glimpses at the head of the Dri Valley. On the 28th April I received urgent appeals from Major Bliss to close down work and return to Sadiyā owing to the hopelessness of the weather and shortage of rations, and again on the 5th May a letter from him reached me reporting that the Ithun Bridge had been carried away by floods, that all persons were to be put on short rations, and that he could not send up any more rations until the Mishmis had constructed one of their suspension bridges across the Ithun. This I knew to be probably a long job and as we had rations sufficient to carry us on to the 16th May only, that must be the date on which we must reach Echindon where more rations could be obtained. We agreed therefore that the 10th May was the very latest date for us to remain at this camp as Echindon was six marches away. The 9th and 10th were cloudy and occupied in doing triangulation computations, and by combining my plane-table rays with several theodolite single rays we managed to fix a few more distant peaks on the main ranges. The 11th was a fine morning and I went up Karundi Hill and completed as far as was possible the survey of the main watershed north of the Andra and Adzon Rivers and as much as was visible of the head-waters of the Emra. By 10 a.m. three of Capt. Bailey's coolies reached us from Mipi and with the help of three more of our coolies (it had taken several days of persuasion and promises of "bakshish" to induce these men to consent to go) Capt. Morshead equipped with a 3-in. theodolite and small plane-table left Karundi for Mipi on his adventurous journey to unfold the secrets of the Tsan-po gorges. It was his intention to carry on triangulation as he went and keep up a plane-table survey on the 8-mile scale. On the 12th I marched down to Yuron Post and with Capt. Hensley reached Echindon Post on the 17th May. Leaving him there to join the proposed one-day raid up the Ithun Valley, I continued the march down to Sadiyā where I arrived on the 22nd May. The march back from Mipi to the Ahsun River, one march short of Nizamghat, was a revelation in showing what can be done in the way of roadmaking by a few sepoys and coolies under the guidance of efficient and keen British officers. With the aid of only a very few iron picks and shovels, with kukries, daos and picks made of hard wood, an excellent 2-ft. coolie track, with a good gradient and good surface, had been constructed for 90 miles, down into deep gorges and then climbing over high spurs, which often necessitated twice in one march an ascent and descent of 3,000 ft. through dense jungle. The track ran along the precipitous rocky hillsides with galleries crossing the vertical face of a cliff and ladders up slippery rock faces 20 or 30 ft. in height; so that instead of crawling along hanging on by one's hands to roots of trees, as was often necessary when advancing up the valley in December and January at a rate of 4 and 5 miles a day, now in May we returned jauntily by marches of 10 to 12 miles

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in length along a comparatively easy road which would be no disgrace to a civilized hill station. It was undoubtedly due to this good road that the supply of rations and communications was kept up intact for so many months without interruption in spite of the continuous heavy rain which was experienced from February to May.

We may now turn to the operations of the Ahui River Party. Owing to the rise in the Dibāng River it was found that the only means of crossing it was by a Mishmi suspension bridge; the nearest footbridge to the Ahui River of this description over the Dibāng is the one opposite Aprunyi Village. It was therefore decided to cross by this bridge and going one march up the Emra Valley strike across the Ahui-Emra Watershed from Aihini Village and enter the Ahui Valley, returning by the same route. On the 24th April, the party under Major Bliss with Capt. Nevill, Political Officer, left Etalin and crossing the Dibāng at Aprunyi marched up the Emra to Epini Post and crossing the Emra at Aihini climbed the watershed and crossed it at 7,000-ft. elevation, establishing a post at Dupo Village in the Bhui Valley on the 1st May. Surveyor Shaikh Muhammad Salik, who had reached Etalin on the 25th April after the Ange River had been completed, left again on the 26th and joined the party on the 29th at Etalin Village in the Ahui Valley. On the 29th news had reached Major Bliss that the bridge over the Ithun River had been washed away by high floods and that rations could not be got across; he therefore with the Political Officer left at once for the scene of the disaster and handed over the charge of the party to Lieut. Lane. The advance up the valley was continued by half marches, at the same time establishing a meeting convoy system capable of carrying a day's rations for the whole party; the surveyor kept up with the party the whole way as far as Chepwe, the furthest post up the valley, which was reached on the 8th May; here he left the main party and with an escort of five sepoys continued plane-tabling up the valley for two marches and getting several fixings on a long spur from 8,700 ft. up to 10,980 ft. elevation, the head-waters, main watershed, and Abroka Pass were successfully cut in; his highest fixing in the river bed was at about 6,500 ft. at a distance of nearly 120 miles from Nizamghat. Returning to Chepwe on the 13th the whole party retired on the 14th and reached Aokan. From Aokan Lieut. Lane with the surveyor and a small escort climbed to Chunmunli Hill (12,243 ft.) reaching the top on the 14th after a long day's march. Unfortunately continuous rain and snow prevailed the whole time they were up this hill from the 15th to 18th and they were unable to get even a glimpse of the Emra head-waters and main watershed which they had gone up to see. On the 18th Lieut. Lane received a letter from me in which I told him that I had managed to sketch in the main watershed at the head of the Emra and

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so on the 19th they left the hilltop and returned to Dupo. The camp was pitched at a height of about 12,000 ft. near the summit of the hill; a thin small bamboo, sticking out through the snow, was the only jungle growth at the camp site, wood was brought up from a spot about 500 ft. lower down where there was rhododendron and oak forest, water was obtained by melting snow.

Leaving Aokan on the 20th the party reached Etalin on the 23rd and marching straight through reached Sadiyā on June 1st. Several large villages of 60 and 80 houses were found up this valley and the Mishmis proved very friendly. The road up the Ahui as far as the village of Chepwe was found to be rather easier than most of the Mishmi paths, but from here onwards the track over the Abroka is difficult and very rocky. There are four different passes from the Ahui to the Emra Valley, two passes to the Sesseri Valley at 8,200 ft. and 9,478 ft. elevation and one pass into the Inlu Valley height 7,500 ft. The inhabitants of the Ahui Valley seldom communicate with villages on the east bank of the Dibāng due probably to the fact that there is no means of crossing the Dibāng direct from the valley except by means of a single strand rope bridge near the village of Engapo.

The full survey detachment having now arrived in Sadiyā, the equipment and instruments were packed up and sent to Calcutta, ordnance stores returned to Allahābād Arsenal, and all menials paid off by the 3rd June. On June 4th the whole detachment left Sadiyā and crossed the river Brahmaputra in the launch *Rover* and on the 5th entrained at Saikhoa Ghat for their various destinations. The superior establishment was attached to the office of the Superintendent, Eastern Circle, and arrived in Shillong on the 6th and 7th June where the mapping of the field work was to be undertaken.

Work Done.—The whole programme as laid down by the Government of India was completed, and the work done may be recapitulated in a concise form as follows :—

(*a*). The course of the Dibāng River has been traced to the source of each of the five large rivers which constitute the main Dibāng. The Nagong Chu is not one of its tributaries but flows in a north-westerly direction from Shuiden Gom-pa and according to Tibetan information, obtained at Mipi Village, joins the Tsan-po (Dihāng) some 11 or 12 marches north of Rinchengpung.

(*b*). The whole basin of the Dibāng, except the Ithun Valley, has been surveyed and the main watersheds from which all the rivers in the Dibāng emanate have been fixed; these watersheds are some 280 miles in length, of this 190 miles have been rigorously surveyed and 90 miles sketched in accurately enough for geographical purposes. The watershed forming the exterior boundary of the Mishmi

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country has therefore been completely surveyed, connecting with the Abor survey on the west and the North Burma Survey on the east: this again also completes the programme of work as laid down by the Surveyor-General to be carried out by the Mishmi Mission Survey in 1911–12.

The areas completed by the party are :—

Detail survey ¼-in. scale	3,523 sq. miles.
Reconnaissance survey ¼-in. scale	945 ,, ,,
Total ¼-in. scale ..	4,468 sq. miles.
Plan survey 6-in. scale	4½ ,, ,,

The number of heights including both clinometric and triangulated is 1,050, which gives an average of nearly one height to every 4 square miles of survey so that the contouring should be a good representation of the ground.

Time Spent in Actual Survey Work.—In order to give an idea of how much actual work may be expected from surveyors on such expeditions as these, I enumerate below the length of time spent on plane-tabling by each individual.

Duration of expedition from arrival in Sadiyā to departure from Sadiyä is eight months :—

Major Gunter	4½ months.
Mr. Abdul Hakk	6½ ,,
Surveyor Shaikh Muhammad Salik	3½ ,,
,, Sheo Lal	3 ,,

The chief reasons contributing to the inability of utilizing the services of surveyors continuously were :—

Supplies and transport were not ready until six weeks after the arrival of the survey party.

The necessarily slow progress of a large force entering a difficult and wild country due to roadmaking, etc.

The necessity of establishing a daily convoy system in touch with the base during the advance. The paucity of coolies, even after advanced ration bases had been established, did not allow of more than two plane-tabling parties and one triangulation party working simultaneously.

The whole of the area under survey was triangulated by Capt. Morshead, and he fixed peaks on the entire main watershed except those portions north and east of the Dri River and north of the Tangon River. This is a fine record for one observer without help of any sort from a recorder or computer, under such trying weather

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conditions as prevailed throughout. Mr. Abdul Hakk supplemented the triangulation up the Tangon and Edza Valleys, but owing to bad weather failed to extend it to the main ranges. The total number of stations of observation is 25 and intersected points 180. Capt. Morshead completed the computations of almost every triangulated point within a few hours of the observations having been made and sent the results to plane-tablers long before the latter required them. As most of the computations were carried out while camped in snow and under very trying conditions it can be realized what a fine record Capt. Morshead has to show for his season's work.

When we found ourselves in the Luhit Valley last year we thought that we had found the wildest and most precipitous country in India, but we were yet to visit the Dibāng Gorges. The precipices and mountain slopes up the Luhit, after having seen the gorges of the Dri, Tangon and Adzon Rivers, pale to insignificance. The road up the Dibāng was one succession of dips down into deep gorges and ascents up over high spurs ; for instance the march from Angolin to Imbolin entailed a climb of 2,000 ft., a descent of 1,500 ft., another climb of 2,000 ft., a descent of 2,700 ft., and a third climb of 3,100 ft., *i.e.*, a total climb of 7,100 ft., and descent of 4,200 ft. ; and again the road from the Emra to the Ahui was a continuous climb of 5,000 ft., during the first march over the watershed. The only piece of country approaching flatness in the whole 4,500 square miles is the "Downs" at the junction of the Dri and Matun, 3 miles long by 1½ miles wide.

The greatest difficulty presented to the plane-tabler owing to the precipitous nature of the country was that of recognizing triangulated points ; ranges consisted of innumerable snow peaks close together and much alike in profile ; looking up at them from below one could never be sure whether the peak visible was the triangulated point on the main range itself or merely the near end of a spur jutting out from the main range. Up the gorges of the Adzon and Dri fixings by resection were impossible and survey up both these rivers was carried on by means of a range-finder traverse with quite satisfactory results. In Annexure A I have written a few notes on the use of the Barr and Stroud range-finder which was used. Throughout the country as a whole plane-table fixings could not be obtained without a climb of 2,000 ft. to 3,000 ft. from the valley road, but in the neighbourhood of the villages the main spurs and the southern side of mountain slopes were usually found to be cleared of jungle, so that fixings were always possible after a climb. Higher up the rivers beyond the villages dense forest was met with on all hillsides and spurs from the river bed right up to elevations of 12,000 ft. and sometimes 13,000 ft. and here of course fixings were difficult to obtain. Without doubt an interesting feature of the country in

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the Dibāng Basin is the unusual steepness of the river gradients. From Nizamghat up the main valley to the junction of the Ahui River the rise is 300 ft. in 23 miles, a gradient of over 13 ft. a mile.

From the Ahui Junction to the Tangon Junction the main river rises 800 ft. in 13 miles or a grade of 61 ft. a mile. From the junction of the Tangon to the junction of the Dri and Matun Rivers the rise is 1,630 ft. in 14 miles or a grade of 116 ft. per mile.

The Tangon rises 2,850 ft. from its junction with the Dri to the Edza Junction, a distance of 24 miles, a grade of nearly 120 ft. per mile.

The Ahui rises 4,000 ft. from its junction with the Tangon in 30 miles or a grade of 133 ft. per mile.

The Adzon rises 3,000 ft. in 17 miles or a grade of over 180 ft. per mile.

The Dri from the Matun Junction to the Ange Junction rises 1,200 ft. in 12 miles, a grade of 100 ft. per mile while in its upper reaches the Dri drops 2,000 ft. in 1½ miles.

It is not surprising therefore that the Dibāng River rushes through the gorge at Nizamghat with such terrific force.

The Weather.—The weather, being a very important factor on the North-East Frontier in survey operations, should occupy a prominent place in every report. Up to January 15th it was very favourable and clear cloudless days were the rule ; only periodical storms lasting two or three days were experienced but after this date the weather broke up and continuous rain, snow and mist predominated up to the very last day of the expedition. The record from 15th January to 15th May when all work was practically completed is as follows : Cloud and mist 38 days, continuous rain 62 days ; clear fine days, when snow peaks were visible, only 21 days. To get only 21 days of fine weather in four months was rather a trying experience, especially to a triangulator. The patience, endurance and professional ingenuity of every member of the party were taxed to their utmost by the disgusting weather conditions and by the enclosed, precipitous and snowbound nature of the country. It would be difficult to imagine worse conditions for survey operations than prevailed throughout the season from January to May.

Health of the Party.—The health of the party was good throughout and the Hazāribāgh tindals and khalasis, with the exception of a few men in the triangulation squad, did very well. One khalasi suffered from frostbite in both feet, but he was recovering rapidly before he left and amputation will probably not be necessary. One of my khalasis fell down a precipice, but was fortunately caught up in a tree some 80 ft. down and on being rescued informed everyone that he was " dead."

A list of principal places of interest fixed during the season is shown in Annexure C.

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ANNEXURE A.

Notes on the Use of the Barr and Stroud Range-Finder as a Traversing Instrument.

The instrument used by me was of the F.T. type with direct image, obtained by the Mathematical Instrument Office from the makers at very short notice last year; it unfortunately arrived too late to be used in the Mishmi Survey of 1911–12. The ordinary stand supplied with the instrument was not used; the Mathematical Instrument Office constructed an adaptor by means of which the instrument was used on the stand supplied with my 3-in. theodolite; this proved a very satisfactory arrangement. The image being magnified 14 times it was very necessary for accurate work to have a firm stand. The great advantage of the range-finder for traversing is that one can use objects on the far side of an impassable river as a forward point; being on the far side of the river also makes the object easier to keep in sight while proceeding to the forward station. My usual procedure was to pick out an object with a straight vertical line, such as a tree trunk or edge of a white rock in a cliff, etc., about 1½ miles ahead, taking care that the object would also be visible from the forward station. Having ranged this, two other objects were also ranged, and entered in the traverse book, in case the first object might not be visible from the forward station—ranges to hilltops, etc., should also be taken—the plane-table being set up rays are drawn to each of these ranged objects, distances plotted and carefully marked and the necessary vertical angles taken with the clinometer. While moving forward it is easy to keep the object in sight, but after it has been passed it is usually found that the object disappears in the most annoying way and for this reason it should be high up and well above the tops of trees in the foreground. Having settled on the new station from which the back object is visible and a good view forward can be obtained, the same procedure of ranging, etc., as at the first station is followed. Observed distances of 1½ miles on the ¼-in. scale having an elevation of 10 degrees or more require a correction to obtain the correct horizontal distance. On the back of my Wahab's Height Indicator were pasted:—

(*a*). A scale of feet. (*b*). Height correction up to distances of 147,000 feet. (*c*). Correction per 1,000 ft. for observed distances up to a slope of 35 degrees. In traversing up narrow gorges, such as

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are met with in the Mishmi country, many of the forward rays may be at a slope of 30 degrees so that the ordinary survey clinometer should be supplemented by the small military pocket clinometer which is quite accurate enough (reads ¼ degree) for short rays.

2. As regards instrumental adjustments, etc., I found that halving adjustment was necessary practically every time the instrument was taken out of its case, the jolting after being carried even for only a couple of miles upset this adjustment. For short ranges up to 1½ miles the mean of three observations is quite sufficient, but for longer ranges such as 6 or 7 miles, five or seven observations are necessary. It is best to range with the right eye only and then read the scale with both eyes open. Coincidence adjustment was necessary only once during the season after the instrument had been tested and set on the roof of the Mathematical Instrument Office, Calcutta. The various mirrors and lenses kept wonderfully clean throughout the season in spite of the intense damp and they were not touched by me once in the eight months.

Every survey party working on the North-East Frontier should have one of these instruments in case work has to be carried up long narrow gorges where the ordinary methods of plane-tabling and traversing are impossible. It is certainly the most rapid method of traversing that I have so far experienced.

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ANNEXURE B.

Notes on Coolie Transport, etc., for the North-East Frontier.

Experience of the last two years shows that the best coolies for the North-East Frontier hills are "Nepalese," the next best are "Gurkhas" and "Gurkhalis" and for work on lines of communication in low ground "Nāgas" are useful. "Bhotiās" are bad as they cannot negotiate the hill climbing, are too slow, and cannot cut jungle. All coolies accompanying a survey party must be fully clothed on the "winter" scale with boots, putties and socks, etc. A supply of green gauze for issue to coolies and khalasis while working in the snow should be taken to prevent snow-blindness.

It is useful to note that whereas up the Luhit Valley all Mishmis take opium in preference to money and for money they prefer 4-anna pieces to rupees; up the Dibāng Valley opium is useless and all money should be in rupees and not small coin. Up the Dibāng Mishmis are fond of "rum" and village headmen become quite communicative and pleasant after a few "tots" of it; they also prize a good large briar pipe, the larger the better, and warm cloth.

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ANNEXURE C.

The chief places of interest fixed by the Survey were :—

(*a*). The main watershed of the Dibāng Basin separating it from the rivers to the west, north and east, about 280 miles in length, all of which was previously entirely unknown and consisting of snow ranges varying in height from 14,000 ft. to 19,000 ft.

(*b*). The Tibetan Village of Mipi in the Matun Valley.

(*c*). The following passes :—

Baisha.—Leading from the Sesseri River to Damro on the Yamne River—1 march. Height approximately 5,000 ft., always open.

Abroka.—Leading from the Ahui River to Simong on the Dihāng River—3 marches. Height approximately 12,900 ft., usually open except in February and March.

Andra.—Leading from Mipi Village on the Matun River to Rinchengpung, Dihāng Valley, and Chimdru—4 to 5 marches. Height approximately 12,500 ft., open from middle of April, but the rivers are not passable during the rains.

Yonggyap.—Leading from Mipi Village on the Matun to Chimdru in Tibet. Mipi to Chimdru is about ten marches. Capts. Bailey and Morshead went over this pass to Chimdru. Height approximately 13,000 ft , open from end of May, but road not passable during the rains.

Aguia.—Leads from the Dri River to Ruipu on the Rong Thod Chu, pass to Ruipu is four marches, seldom used and is in permanent snow. Height approximately 17,000 ft., open during November only.

Kaya.—Leads from the Tangon River to Alupu on the Rong Thod Chu, reported one march. None of the passes except the Baisha are passable for troops or large bodies of men without many days' roadmaking, and then only in fine weather. Height approximately 15,700 ft., open in November only.

(*d*). Many magnificent waterfalls and cascades up the Adzon and Dri Gorges and at Yuron Village, varying in height from the Yuron Fall, 1,500 ft. to the Detza Falls on the Dri over 3,500 ft.

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THE ORGANIZATION OF ENGINEERS.

By MAJOR J. E. E. CRASTER, R.E.

War Duties.—The duties of military engineers in war may be grouped under the following headings:—Fortification, both field and fortress; demolitions; sapping and mining; bridging; water supply; roads; railways; telegraph and telephones; searchlights; surveying, and, in addition, all civil engineering and building work within the area of operations for which civilian engineers are not immediately available.

Peace Duties.—Their peace duties include the construction and maintenance of fortifications, military buildings, military railways, telegraphs and telephones, searchlights, and surveys.

Organization.—For these duties in war and peace the engineers of civilized armies are organized on two rival systems. The first may be described as the "single corps" system.

The Single Corps System.—In this organization the whole of the above duties are allotted to a single corps, the officers and men of which are available for any, or all of the duties. This is the system that has been adopted in the British Army.

The Multiple Corps System.—The second is the "multiple corps" system. Under this organization the various duties are performed by corps of specialists, which are not available for other duties. This system has attained its extreme development in the German Army. There are companies of pioneers, whose duties are confined to field defences, siege work, demolitions, and bridging. A corps of engineers, composed entirely of officers, which is allotted to the various fortresses. A corps of fortress constructors, for the building of permanent fortifications; field searchlight units; railway troops, subdivided into construction, traffic, and works companies; telegraph troops, subdivided into telegraph and telephone companies. A Garrison communication staff for fortresses. A barrack construction department, a survey department, forming part of the General Staff.

All these various corps are on separate rosters for promotion, and no officer or man can be transferred from one to another against his wishes, nor can he be called upon to perform duties that do not appertain to his own particular branch.

The Two Systems at Work in 1900.—An excellent example of the working of the rival systems was afforded during the operations in

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North China, in 1900 and 1901. The Army of one of the Continental Powers put in the field a large number of engineers, composed of pioneer companies, telegraph companies, railway construction and traffic companies. It happened that the telegraph company had more work than it could cope with at the time when the railway troops were unemployed, yet owing to the multiple corps system the telegraphists could get no help from the railwaymen. Later on the railway companies were overworked, while the pioneer companies were doing physical exercises to keep the men fit.

The engineers with the British force in North China consisted of three companies of Sappers & Miners, a telegraph section, a railway section, a balloon section, and various details from the Fortress Companies at Hong Kong.

Owing to the railway being at first in other hands, the British railway section had no railway work to do, and it was therefore delegated to other duties. The officer commanding the railway section, for instance, was employed in making a survey and reconnaissance at Peking, pending the arrival of the survey section.

It was found that one telegraph section was not enough to cope with the work, so another was raised at once from one of the companies of Sappers & Miners, two or three electrical experts being added from the Hong Kong fortress details. This telegraph section replaced all the field lines and cables, with permanent air lines. As soon as the work was finished, the section was broken up, and the men were returned to their own units.

When the railway was handed over to the British, the companies of Sappers & Miners were called in to help the railway section to reconstruct the line, and the officer commanding the balloon section, who had had much previous experience of railway work, was made Director of Railways.

In this way the whole of the work that fell to the engineers was performed without delay, and the British force was ready for any further field operations that might have been required, before its European allies had established trustworthy communications even with Peking. In short, the operations in North China resulted in the complete triumph of the "single corps," over the "multiple corps" organization.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF SEBASTOPOL (*continued*).

It is time to be passing to the camp of the French and the English. It has been shown what the condition of Sebastopol was during those last days of September, and it may be asked why it was that the invaders, now able to gaze at their ease on the domes of the coveted town, did not move forward to seize it.

On the 27th September, the day the French completed their flank march and the second of the days during which the deserted garrison had been left without tidings of Prince Mentschikoff's Army, both the French and the English pushed forward some troops towards Sebastopol, and from the southern side of the town effected their first reconnaissance of its defences.

Seeing the entrance of the roadstead blocked up, the Allies were not without means of inferring that the resources of the Black Sea Fleet, both in men and material, must become available for the land defences; and they were witnesses of the energy and haste which the garrison thought it needful to exert in trying to strengthen their lines, for upon the points upon which their field-glasses were directed there were thousands of men and women at work.

The cardinal question which had to be solved was whether the Allies should now follow up their hitherto victorious march, and endeavour to carry Sebastopol by a prompt and determined attack, or whether they should consent to give the enemy breathing time and begin upon a slow plan of warfare resembling a siege.

Before the 27th September closed bold counsel had been offered by Admiral Sir E. Lyons, and the fact is recorded that having made himself in a general way acquainted with the state of the defences which covered the land front of Sebastopol, and believing them to be imperfect and weak, he urged at the English headquarters the expediency of an immediate assault. Lord Raglan was of the same opinion, but the notion of an assault without first reducing the fire of the place by means of heavy artillery was not favoured by Sir John

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Burgoyne, and the proposal having been submitted for consideration to the French, General Canrobert refused to adopt the measure.

So now the Allies took a step, not in itself decisive, but tending to govern their fate, by ignoring the all-vital question of time, and adopting a plan, smooth and easy enough at first sight, but which might yet lead to trouble. They requested the naval commanders to land the siege trains. Their purpose was to open the way for assault by first getting down the enemy's fire.*

On the 28th the seamen were busily engaged in landing the siege trains, and at this time Sir George Cathcart began to urge that the attack upon Sebastopol should be of a summary kind. There was however no change of opinion in the French camp. Apparently they were all of one mind, the reason given, among several others, being "that they would have to move under the fire of the enemy's batteries for a space of some 2,000 yards. They would have to traverse ground quite unknown to them. Any attack upon the enemy's defences must be made from an extended diverging circumference; and the assailing forces would be so split by these deep intersecting ravines, as to become divided into isolated bodies of men incapable of giving one another any mutual help."

The combined arguments of Lord Raglan, Sir Edward Lyons and Sir George Cathcart in favour of an immediate assault were of a most cogent nature. They may be thus summed up: "Here, on this barren shore we stand fastened—inexorably fastened—to the duty of taking Sebastopol; and for an army in such a predicament as this, the adoption of even a very hardy measure may not only be free from the charge of rashness, but may be commanded by the strictest prudence."

Without the concurrence of Marshal Canrobert there could of course be no assault, and as he did not concur, and any endeavour to shake his decision was clearly hopeless, the question was ended. What the Allies now undertook when they resolved not to assault the place immediately was to open some trench work in which to plant their great guns, and with these to cannonade the fortress. In other words they had determined to enter upon the Siege of Sebastopol. It was with the hope of inducing the Allies to come to this very resolve that the defenders of Sebastopol had been toiling.

The great Engineer who directed the labours of the garrison has declared that the place, at that time, could not have been held against such an attack as the Allies had the power to make; and this is the judgment of one who, compared with all other men, had the fullest understanding and knowledge of the question on which he was writing.

* Sir John Burgoyne's *Military Opinions*, p. 181.

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The condition of things in the Crimea, after the battle of the Alma, was such as might well have contented the Allies had they looked upon the expedition as one to be carried through swiftly, in the first week after the victory. Yet it would be likely to be hard against them, from the moment, when setting themselves against the judgment of Lord Raglan, and Lyons, and Cathcart, they reasoned away their first boldness, and wilfully suffered the enterprise to degenerate into a siege.

In adapting the disposition of their troops to the undertaking now about to begin the Allies had two objects before them; they had to provide for the duties of the intended siege, and also to secure their forces as well as they could from interruption on the part of the enemy.

With this twofold purpose in view General Canrobert divided his army into two bodies, each consisting of two French divisions. Of these two corps, one only, consisting of the 3rd and 4th Divisions, and placed under the orders of General Forey, was charged with siege duties. It encamped with its front towards the town of Sebastopol, its left resting on the sea, and its right extending to the Harbour Ravine. The French forces drew their supplies from the Bays of Karniesch and Koratch.

On the other hand Lord Raglan devoted everyone of his infantry divisions to the business of the siege,* but his troops were so posted, that while they had thus cast upon them the duty of pursuing the siege, they were also liable to be summoned to the task of defending the Chersonese at its north-eastern angle.

The English Army had its left at the crest of the ravine which divided our lines from the French, and thence it extended eastward to ground not very far distant from the crest of the Saponné Ridge. The English Army drew its supplies from Balaklava, and at first by two routes; for until the 25th October the Woronzoff Road, as well as by the way of the Col was open to the besiegers.

The task of covering the siege, by defending the Col, and the greater part of the Saponné Ridge, was assigned to the 1st and 2nd Divisions of the French Army under the command of General Bosquet. The Turkish battalions under the orders of the French commander took part in the same duty. General Bosquet, however, did not occupy the more northerly part of the Saponné Heights; for there the right wing of the English, though also engaged in the siege stood charged to defend the position.

The Allied Armies were to be covered by the sea on the north-west as well as the south; and on the more southerly portion of the

* The infantry forces detached were only one battalion, the 93rd, and some weakly men not in a condition for hard duty, together with one field battery.

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Saponné Heights they were to be defended by Bosquet's Corps; while against any sortie from Sebastopol directed upon the French or English trenches, the besieging forces would of course be their own defenders.

So long as the English drew their supplies from Balaklava it was necessary, of course, that that harbour should be secured; and this place was on the outside of the natural rampart that guarded the table-land. It therefore required a separate system of defence. For this so far as concerned its eastern approaches, the steep lofty hills, which soon came to be known as the "Marine Heights," were so well fitted as to be capable of being rendered formidable by even the slight works which could quickly be constructed for the purpose; and a redoubt with a line of breastwork extending athwart the entrance to the gorge by the village of Kadikoi, was to complete the "inner line" of the Balaklava defences. It was afterwards determined that an "outer line" of defence should be constructed by throwing up a chain of small redoubts upon the low range of heights which stretches across the plain at a distance of about a mile and a-half from the gorge leading into Balaklava.

Lord Lucan with his cavalry and horse artillery was stationed in the plain to the north of Balaklava, with orders to patrol to the Tchernaya, and also in the direction of the gorges leading into the valley of Baidan. With the exception of this division of cavalry, the whole of the scant forces entrusted with the defences of Balaklava were placed under the orders of Sir Colin Campbell.

Both the English and the French headquarters were established on the Chersonese—the English in a farmhouse a little to the north of the pass which led up from Balaklava, and the French at a spot further west.

Wharves had at once to be made for the purpose, and the Allies went on in all haste with the toil of landing their siege trains. There was yet the still harder task of bringing up heavy guns from the shore to the front, great stores of ammunition and the loads of material required for the business of the siege work besides all the usual supplies which were needed for the support of their armies.

The French had spacious landing ground in the Bay of Karniesch but it was otherwise with the English, for there soon came the first stress of that want which was destined to be the cause of cruel suffering to their army. The forces, encamped on the Chersonese, were near, it is true, to their port of supply, but not in contact with it. There was a distance of 6 or 7 miles which had to be conquered. And how? It would seem that the only means of transport available to our engineers were some light bullock carts of the country, amounting at first to forty-six, but reduced by the 20th October to twenty-one; and the only way this scant command of draught power

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could be augmented, was by pressing into the service every spare ammunition and baggage horse.

Large bodies of men were landed from the Allied fleets, and they were ordered to take part in the active operations against Sebastopol. The brigade of English seamen then placed under the orders of Capt. Lushington, and Capt. Peel* undertook a battery with his men from the *Diamond*. Large quantities of the armament and other material resources of the fleets were also freely devoted to the same purpose. Numbers of ship's guns of heavy metal were taken from the decks of the men-of-war, and dragged up to the camp by the sailors.

The process of landing battering trains and bringing them up to the front was too difficult to be got through in the short space of time that was thought sufficient when the Allies resolved to enter upon the siege ; and before they were ready to open the first trench, the enemy's field army began to show signs of changing the attitude to which its chief had condemned it since the day of the Alma. Prince Mentschikoff must have been told by his own officers, as early as the 28th or 29th September, that the Mackenzie Height was clear of the invaders, but for several days he made no movement. By the 7th October, however, the Russians had begun to appreciate the fact that, after all, they were once more the undisturbed masters of the Mackenzie Range, including every road and pathway which connected it with the valley of the Tchernaya. So now at last the Russian commander accepted this priceless dominion of territory which secured his communications with Sebastopol and the interior of Russia, but pushed his reconnoitring forces down into the plain, and even to the banks of the stream where the British Cavalry patrolled. At this time, moreover, it began to appear that the forces which constituted the garrison of Sebastopol were daily becoming more bold, for (supporting them in some instances with field guns) the enemy now kept his outposts so firmly on ground far in front of his works, as to hinder the Allies in any attempt to establish batteries at a moderate distance from the place.

The part of the enemy's defences which offered to his assailants the obvious " front for attack " was that slightly curved belt which included the Flagstaff Bastion, the Redan, and the Malakoff Tower. This last work, or rather the ground on which it stood, had been pronounced by Sir John Burgoyne upon his surveying the ground to be the key of Sebastopol. But the Malakoff was not " the key " in such sense as to imply that it was the only key of Sebastopol ; and it was the opinion of General Todleben that the capture of any

* Afterwards Sir William Peel who was in command of the Naval Brigade at the capture of Lucknow in 1858, and who died from small-pox shortly after the siege.

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one of the three works—the Malakoff, the Redan, or the Flagstaff Bastion—must have carried with it the fall of the place.

Straitened in their choice of the "front for attack" the Allies determined that they would devote their first efforts to carrying the Flagstaff Bastion and the Redan, and they hoped that the mastery which might thus be attained would insure, with but little delay, the fall of the Malakoff itself, and all the other defences. It was by the eventual assault of the Flagstaff Bastion and the Redan, that the French and the English expected to be able to carry them. To prepare the way for this enterprise, they not only endeavoured to keep down the fire of these works, but of all the intermediate batteries as well on shore or ship's decks, which helped the defence of the place on its land front. It was also their object to do all they could towards silencing, on the one side, the Central Bastion, and on the other, the Malakoff Tower. The first step towards the execution of this plan was, to draw the investment closer, and to push forward some of the infantry battalions to ground nearer the place; and this with the view to obtain for the engineers better means of reconnoitring, and also to support the working parties in their endeavour to open trenches at a moderate distance from the enemy's works.

On the 7th October, Lord Raglan assembled the Generals of the Infantry Divisions* and announced to them what he wished to have done; but the practical conclusion attained by the council was the rejection of Burgoyne's proposal for a closer investment of the place. Lord Raglan seemed to ascribe to the decision of his Divisional Generals, the necessity of confining the operations of the English Army, and apprehended that for the time and until the moment for assault should be ripe, that army must confine itself to such an operation as would enable the engineers to place in battery some guns of long range.

In pursuance of their plan of attempting something against the shipping and the other defences by their long-range guns, the English on the nights of the 7th and the 8th October, began the formation of two half-sunken batteries upon spots very distant from the enemy's line of works.†

After sunset on the same day as that on which the English generals had delivered their opinions, nine French battalions commanded by General Lourmel were pushed forward, and established in a sheltered position, beneath the commanding crest of Mount Rodolph, where the French meant to plant their batteries.

It was on the night of the 9th October that the French were to

* Sir George Brown, the Duke of Cambridge, Sir de Lacy Evans, Sir Richard England and Sir George Cathcart.

† About 2,800 yards from the nearest of the enemy's works.

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break ground. Advancing from the ground where Lourmel had established himself, their engineers, with a large body of men told off for the work, were to fasten at once upon the crest of Mount Rodolph; and this they proposed to do by throwing up a gabionade a few yards in advance of the ground they had selected as the site of their intended batteries. This gabionade was intended as a screen for the subsequent operation of sinking the trenches in which their batteries were to be placed. The night was clear, and a fresh wind blew from the north-east, which prevented the garrison from hearing the sound of the pickaxe. Relays of working parties numbering 1,600, worked all night without being molested, so that when morning dawned, they had thrown up a work 1,100 yards in length at a distance of about 1,000 yards from the Central Bastion.

The enemy often busied himself with sallies at night, and the cannonades with which he assailed the besiegers and their works rarely ceased for any length of time, and were sometimes of much power. In the space of a single hour on the 14th October, 800 cannon shot were fired against the works of the French, resulting in a good deal of damage to the parapets, but killing only two men, and wounding three. Whilst the French, in most places, had beneath them a fair depth of earth, the ground in front of the English was almost bare rock covered with soil a few inches deep.

On the nights of the 10th and 11th October, the English succeeded in opening the trenches on Green Hill, as well as on the Woronzoff Heights; and it soon appeared that the fire they were preparing was likely to prove much more effective than they had ventured to hope for. By the evening of the 16th October the English had established their batteries and were ready, with the French, to open fire on the following morning.

The English were to be ready to storm the Redan as soon as the French operations should be ripe for a like effort against the Flagstaff Bastion.

The English were put to great straits for want of timber, owing to the platforms sent out with their siege trains being of a new and ingenious kind, which, though promising to serve its end admirably when tried upon a perfect level at Woolwich, turned out to be altogether unfitted for the rocky and uneven ground where our batteries had to be placed. So the platform of the old-fashioned pattern had to be resorted to, and, to meet the emergency most of the few buildings which stood on the Chersonese were quickly stripped of their roofs.

At this time there was a strong desire that the fleets should take part in the attack upon Sebastopol, but there was a difficulty indicating a way in which it would be prudent for their co-operation. On the 15th October a naval conference was held on board the *Mogador* and after much discussion a plan of the naval

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attack was determined upon on the 16th October. As late as the 5th October, the Russian forces defending the quarter of the Malakoff Tower were judged to be deficient in military strength, and Prince Mentschikoff yielding to the advice of Admiral Korniloff, without calling a council of war, suddenly to the joy of Sebastopol made it known that some twelve battalions should at once be detached from his field army, and be allowed to take part with the garrison in the defence of the place. Two other battalions were also brought over from the north of the roadstead; and from time to time afterwards, further bodies of infantry detached from Prince Mentschikoff's Army were sent to strengthen the garrison. This resolution of Prince Mentschikoff to send reinforcements from the field army was apparently decided upon in consequence of a step taken by Admiral Korniloff which seemed to provide that in case of Sebastopol falling for want of aid from his army, the truth should be visibly extant. The latter framed and signed a remonstrance against the plan of continuing to withhold the entire field army from the defence of Sebastopol, and Korniloff apparently intended that whether he were destined to survive or to perish along with the fortress, his words should go to the Czar.

By the 6th October more than 25,000 men of the army had joined the sailors to help in the defence, the total amounting to nearly 38,000 doing duty on shore, and in the course of the ten days which followed the 6th October the garrison was yet further reinforced.

During this time Todleben with restless energy had been pressing on the defences; and it seems to have turned out that the respite of 20 days with which the Allies had been indulging Sebastopol, was just of the length that the garrison needed for bringing the works commenced since the 26th September to a state of all but completion.*

On the evening of the 16th October, the garrison knew that the time of preparation was almost at an end, and that a great cannonade of their works was likely to begin on the morrow. At half-past six a.m. on the 17th October, three shells were to be discharged from one of the French batteries, and then forthwith the Allies were to open fire along the whole line of their works. The following are the details of the Russian guns:—

Guns opposed to the batteries of the Allies ..	118
Guns sweeping the approaches	160
Guns for taking the besiegers when at close quarters in front or flank	63
Total ..	341

* Todleben, p. 301.

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The signal had not yet been given when at daybreak the Russians were able to see that the Allies during the night had cut their embrasures and that their guns were visible. A body of French tirailleurs with a support pushed forward towards the enemy's lines. Sebastopol beat to arms. The three appointed signal shells were fired. In a minute some English guns opened; and presently along their whole line of batteries, and along all the enemy's works from the Central to the Flagstaff Bastion, and thence across to the Redan, and thence on again to the Malakoff, a heavy cannonade commenced.

So long as the conflict was one between covered batteries on one side and covered batteries on the other, there could not well be any approach to equality in point of losses between the besiegers and the besieged; for the Russians were not only forced to keep manned the 223 guns which they had prepared against the expected assaults, but also to have close at hand near the gorges of their bastions the bodies of infantry which they designed to meet the same contingencies. Both the gunners and the infantry were imperfectly sheltered from the fire from the batteries of the Allies and the result was that the troops thus kept in expectation suffered many casualties in killed or wounded, whilst the besiegers on the other hand, were able to keep out of fire the troops with which they meant to assault till the moment for their onset had come.

The instant he heard the opening of the cannonade Korniloff galloped off to the Flagstaff Bastion. Korniloff conversed with the gunners, and to some of them he gave directions as to the pointing of the guns. "Calm and stern," says one of the staff who rode with Korniloff, "was the expression of his face, yet a slight smile played upon his lips. His eyes shone brighter than was their wont. His cheeks were flushed. He carried his head loftily. His thin and slightly bent form had become erect. He seemed to grow in size."

Gaining at length the Central Bastion, Korniloff there found Admiral Nachinoff toiling hard at his duty and seeming to be as much at home in the batteries as though he were on board his own ship. He afterwards visited the work at the Land Quarantine and seeing that the men were suffering from thirst, he gave orders for handing up casks of water to the batteries.

After changing the position of the Moscow battalion by moving it to ground where it would be sheltered from the enemy's fire Korniloff passed the dock-bridge and began to ascend the western slope of the Malakoff. When he came near the seamen on duty in that part of the field they greeted him with loud cheers; but Korniloff forbade them. He pointed to the crest of Mount Rodolph where all was now hushed, owing to the French batteries having been silenced by the Russian fire, and said to his people, "When

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the English batteries are as silent as the French yonder, then, and not till then you may cheer."

When Korniloff reached the Malakoff Tower he found that its guns had been silenced and deserted; but Admiral Istornin still answered the English by a well-sustained fire from the earthworks which covered and flanked the stone building. It occurred to Korniloff that the ground floor of the tower would be suitable for an ambulance or field hospital and he gave directions accordingly. After this Korniloff remained for some time at the foot of the tower. His aide-de-camp begged him to return home; and in answer he pointed to the ground where the Bontir and Borodino Regiments were stationed, saying, "We will just go to those battalions, and after that we will go home by the hospital road." He still loitered for a few minutes longer, but at length—it was then half-past eleven o'clock—he said "Now let us go." He moved towards the spot under shelter of the breastwork where the horses were awaiting him; but he had scarcely yet taken four steps when the uppermost part of his left thigh was shattered by a round shot. Gendre raised the head of the wounded chief, and the other officers near coming up and lifting him in their arms, they together laid their Admiral under shelter of the breastwork, between two of the guns. For a moment Korniloff was able to speak, and he said feebly "Defend Sebastopol." He then became senseless. He was carried to the hospital, suffering greatly; but at a moment when he was free from sharp pain, he laid both hands on the head of the Chief of the Staff and said, "Tell everybody how pleasant it is to die when the conscience is quiet." He sent tender words to his wife and children; and from time to time he prayed thus, "O God! bless Russia and the Emperor. Save Sebastopol and the fleet!" Shortly afterwards he became insensible. After a few minutes he ceased to breathe. An effort was made to conceal the death of the Admiral, but upon coming to know the truth, the sailors, and the soldiers too, grieved bitterly for the loss of their trusted chief and dictator. From time to time there had been posted up numbers of general orders, in which Korniloff gave directions tending to relieve the sufferings of the men, and in many ways add to their comfort. These announcements remained on the walls long after the death of the chief whose name was at the foot of them; and the grateful men as they passed, used to look up and point to the words, and bless the memory of their hero, saying often in that gentle and poetic spirit which is characteristic of the Muscovite people, "Our Admiral still watches over us!"

It had been originally determined apparently that the attack of the forts should be executed by ships which, keeping always in movement, would deliver their fire in succession and that the attack should commence at half-past six on the morning of October 17th, but at the last moment Admiral Dundas in command of the British

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Fleet received a communication from the French Admiral Hamelin that he did not intend to commence his fire before 10 or 11 o'clock, as his shot would not last long, and if expended early, the enemy might think that he was beaten off. Dundas acceded to the reason which Hamelin adduced, and consented to the proposed change of time.

At 7 o'clock on the morning of the 17th Admiral Hamelin to the astonishment of Dundas came on board the *Britannia* and announced a new plan of attack. By this new plan it was laid down that instead of an operation effected by ships kept in motion, the two fleets while engaging the forts, should be anchored in line; that the array of the French fleet should begin at Chersonese Bay, proceeding thence in a north-north-easterly direction to a point opposite to the centre of the harbour; and that from thence, but in a line taking a north-easterly direction, the English fleet should be ranged. The French fleet would thus be at a distance of from 1,600 to 2,000 yards from the Quarantine Sea Fort—the nearest of the forts which it proposed to assail—and that the English fleet would have to engage Fort Constantine at ranges equally long.

This was the plan which the French had decided to carry out. Admiral Dundas was so reluctant to adopt a measure which he considered would be mortifying to the self-respect of our Navy that until Admiral Hamelin had declared that the French were determined to adopt this course he withheld his assent.

It was apparently in a spirit of devotion to a forlorn duty that Dundas chose the place in which to put his own flagship; for when in the course of a conference of admirals and captains that had been previously held, an officer whose opinion was weighty, pointed out that the ship which should be on the extreme right of the English line must of necessity be sunk in one hour, Dundas quietly answered that that post was the one he had reserved for the *Britannia*.

So large a proportion of the defensive works had been designed for the purpose of preventing an enemy's ships from entering the roadstead, that not counting the two small works, the Wasp Tower and the Telegraph Battery, three only of all the water-side forts were so placed as to be able to take part in an engagement with ships keeping clear of the entrance. These three forts were Fort Constantine, Fort Alexander, and the Quarantine Sea Fort.

This being a condensed history of the sieges in which the British and Indian Armies have been engaged, and being limited in size, it has been found necessary to exclude the account of the naval engagements of the 17th and 18th October, the details of which are fully and admirably related in Chapters XVII. and XVIII. of Kinglake's *Invasion of the Crimea*. It will be sufficient to recall that

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the results of the naval actions were on the whole more favourable to the Russians than to the Allies.

In a categorical form the five results evolved by the conflict may be thus summed up.

1. At ranges of from 1,600 to 1,800 yards, a whole French fleet failed to make any useful impression upon a fort at the water's edge, though its guns were all ranged in open-air batteries, and firing from over the parapet.

2. An earthen battery mounting only five guns, but placed on a cliff at an elevation of 100 ft., inflicted grievous losses and injury on four powerful English ships of war, and actually disabled two of them, without itself having a gun dismantled, and without losing a single man.

3. At ranges of from 800 to 1,200 yards, and with the aid of steam frigates throwing shells at a range of 1,600 yards three English ships in 10 minutes brought to ruin and cleared of their gunners the whole of the open-air batteries (containing 27 guns) which were on the top of a great stone fort at the water's edge.

4. The whole Allied fleet operating in one part of it at a range of from 1,600 to 1,800 yards, and in another part of it at ranges of from 800 to 1,200 yards, failed to make any useful impression upon casemated batteries protected by a good stone wall from 5 to 6 ft. thick.

5. Under the guns of a great fort by the water's edge, which although it had lost the use of its topmost pieces of artillery, still had all its casemates entire, and the batteries within them uninjured, a great English ship lay at anchor at a distance of only 800 yards, and fought for hours without sustaining any ruinous harm.

October 17th.—Whilst the fleets plied their thunder in vain and the guns on Mount Rodolph were still silent, there was one part of the field where the cause of the Allies seemed to prosper. This was in the English batteries. There from break of day our gunners, sailors and landsmen, had been well fulfilling their part. Not only had they sustained with advantage their now single-handed conflict with the Flagstaff Bastion and the "Garden Batteries," but they were fast achieving almost all that could have been hoped from their efforts against that part of the enemy's lines in the Karabel Faubourg which they more especially undertook to assail. The batteries in both Gordon's and Chapman's attacks were so placed and were armed with guns of a calibre which compensated so aptly for the length of the range that after some nine hours of firing, they had established a clear ascendancy over the enemy's ordnance.

Though with somewhat less advantage in that respect, than the French, the English were still upon heights which commanded the

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Russian defences, and looked over into their rear. From this cause as well as from the effect of shot bounding in by *ricochet*, our guns from the first, had begun to work a great havoc in those parts of the Russian batteries which lay towards the gorges of their bastions, as well as among the bodies of troops which were posted hard by to await the expected assault.

But this was not all; for little by little the whole front of the assailed defences in the Karabel Faubourg began to give way under the power of the English artillery. Even from the Allied lines it was easy to see that independently of the effect produced by explosions, the shell or round shot alighting upon a parapet which was no more than a heap of loose particles, wrought changes in its bulk and its form and whirling into the air at every blow a dark column of dust and small earth. Before the day was half spent, the frail ramparts most battered by our artillery had degenerated into shapeless mounds; and after the first nine hours of the cannonade there was more than one spot where they seemed to be nearly effaced. In the midst of the earthworks thus almost dissolved into dust the stone-built tower of the Malakoff still remained upstanding; but the work had undergone a fire so powerful that it no longer carried an effective armament. Of its few guns, all ranged in open-air battery at the top of the work, some had been not merely dismounted, but even hurled over the parapet. The stone parapet of the tower also was so shattered, and its splinters flew so destructively, that without incurring an unwarrantable sacrifice, the men at the top of the work could no longer be kept to their guns, and were withdrawn. A well-sustained fire from the guns still poured on the glacis of the work, but the tower itself was silent.

At an early hour in the forenoon when de Todleben surveyed the Redan its defences had fallen into a critical state. Even then several pieces had been dismounted, and numbers of the embrasures were blocked up with ruins. By about 3 o'clock p.m., one-third of the pieces which armed the work had been dismounted. The loss in men had been heavy. The gunners of several pieces had had to be replaced by fresh hands twice. Of 75 men sent to the Redan from one of the ships, 50 were killed or wounded. Yet in spite of the decisive and increasing ascendant thus established against them by the English, the gunners in the Redan stood firm. However appalling the slaughter, the men yet remaining alive and unstricken worked on with a courage which did not droop. The officers did not hesitate to give examples of devotion. They mounted the parapets, and toiled at the repairs to the embrasures.

Soon after 3 o'clock, however, there occurred a disaster which completed the ruin of the work. A shell blew up the powder

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magazine established in the salient. When the smoke lifted a dire spectacle of ruin was disclosed. At the fore part of the work the parapet had been thrown over into the ditch, and so filled it. The ground was laden with fragments of platforms, with guns dismounted, with gun-carriages overthrown, and shattered. On all sides there were the blackened bodies of men and it was afterwards known that more than 100 had been killed.

The troops which had been kept near the gorge of the Redan in order to meet an assault, all at once fell back for shelter towards the Marine Hospital. "Thenceforth," says de Todleben, "there disappeared all possibility of replying to the English artillery. The defence in that part was completely paralyzed; and in the Karabelnaya men expected to see the enemy avail himself of the advantage he had gained, and at once advance to the assault.*

But it has to be remembered that whenever the English should be assaulting the Redan, the French were to be assaulting the Flagstaff Bastion. According to the understanding between the French and the English headquarters, the one assault was not to be going on without the other; and it seems to have been not so much stated in terms, but rather taken for granted, that the silencing for the day of the batteries on Mount Rodolph carried with it a corresponding postponement of any attempt by the French to assault the Flagstaff Bastion. Thus the tender exigencies of the bond which united two mighty states forbade them the full use of their strength. A tacit compact required that their armies should act together in any great operation; and it chancing at this time, from the mere fortune of war, that the English were in a condition to assault and the French not, it resulted as a natural consequence, that the temporary impotence of the one Power carried with it the abstention of both. What benumbed the Alliance was the Alliance.

After the failure of the 17th October the Allies had determined to undertake a new plan of attack. The French were now to proceed against the Flagstaff Bastion by regular approaches. The English, it was known, with difficult ground in their front, and having but scant means of carrying on extensive siege works, would be able to do but little towards attaining the Redan by regular approaches; but it was agreed that whenever the French should be ready for the assault of the Flagstaff Bastion, the English at one point or other, should also storm the defences. On the night of the 17th October the French so prolonged their first parallel as to disclose their new plan of proceeding against the Flagstaff Bastion.

It was determined, however, that pending the time which would be occupied in proceeding by regular approaches, the cannonade

* de Todleben, p. 329.

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should go on, and on the 18th October the English still maintained the fire of their batteries as the French had not only been repairing the havoc made in their works, but establishing new and powerful batteries; and as it was known that on the morning of the 19th, they would be in a condition to open their fire with largely increased means, the hour of trial was looked forward to with great interest by the Allies.

But the preparations of the French were under the eyes of Colonel de Todleben; and he evidently assured himself that, so long as they might continue to assail him from a narrow point of fire, he would be able to keep his ascendant, by meeting their increase of armament with an increase yet greater than theirs. And de Todleben got the ascendancy. Two of the French batteries were visited by the calamity of explosions; a third was silenced by fire, and at 3 in the afternoon there was no longer any French battery which continued the strife. The English fire was continued with great energy the whole of the day, and directed for the most part against the Redan. At evening the cannonade ceased. No material injury had been done to the works of defence; but in killed and wounded this day the Russians lost 516 men. Every day from this time until the evening of the 25th October the fire of the Allies was continued, but every day it was met by de Todleben with a ceaseless energy.

The French at this time, with their magazines often exploding, and their batteries often enfiladed by new works thrown up for the purpose were undergoing a trial of such a kind as might tend to make them distrustful of their own engineers. They hardly understood at the time the true root of the evils which beset them, but that which really stood in their path was warlike genius.

Under the direction of de Todleben, the Russians, by fighting their batteries with unsparing valour, and achieving at night immense labours, were able to present to the besiegers every morning a line of defence which was not only strong and unbroken, but even augmented in strength; and they also found means to provide themselves, as the struggle continued, with a more and more efficient protection against the missiles.

On the 18th (when only the English were firing) the Russians in killed and wounded lost no less than 543 men; but although during the six days which followed the 19th October, a cannonade equally vigorous was maintained by both the French and the English, yet during that period the average daily loss of the Russians in killed and wounded was reduced to 254. The whole loss in killed and wounded which the Russians sustained from the siege down to the 25th October was officially stated to be 3,834. From the moment when on the morning of the 18th October, de Todleben saw how the French on Mount Rodolph had newly opened the ground along a distance of 400 or 500 yards, he had

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assured himself that they had determined to assail the Flagstaff Bastion by regular approaches. As an engineer he entirely approved their decision. By means of a change in the organization of the night outposts, he was able to inflict much heavier losses than before upon the French working parties; but he also constructed fresh batteries, so ordering his measures that the nearer they might draw their approaches the more he would be able to ply them with fire, and adhering to his favourite principle, he never ceased to take care that, whenever the moment might come for assaulting the work, any troops employed in the enterprise should be under a storm of mitrail.

(*To be continued*).

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TESTS OF REINFORCED CONCRETE BRIDGES ON THE GREAT CENTRAL RAILWAY.

MR. JAMES BENJAMIN BALL, M.INST.C.E., recently read a paper at the Institute of Civil Engineers and by the kindness of the Secretary we are enabled to publish the following abstract :—

The Great Central Railway Company have completed within the last six years several considerable works in reinforced concrete, the more important of which include a bridge carrying a public road over their main lines at Ashton-under-Lyne—believed to be one of the heaviest reinforced-concrete bridges of its type yet constructed in England—a bridge carrying a new road and tramway over the Grimsby District Light Railway at Immingham Dock, and several reinforced-concrete bridges in the dock area at Immingham.

Reinforced-Concrete Overbridge, Ashton-under-Lyne.—This bridge consists of parallel girders of three spans. The main girders also form the parapets of the bridge. On a level with the bottom booms are formed the main deck beams or cross-girders, and between these again are the smaller deck beams parallel to the main girders, supporting the reinforced-concrete decking. The entire superstructure is reinforced with round bars on the Hennebique system.

The abutments at each end are of mass concrete, but the piers are braced and reinforced. The main girders only rest on the abutments and are not anchored down in any way ; moreover, they are not continuous, there being a space of 1½ in. between the girders over each of the intermediate supports for expansion : thus each span is independent, and consequently any slight settlement which may take place in the abutments or piers will not affect the stresses on the reinforcement, and in each case the full bending-moment effects due to both dead and live loads were taken into account.

Both tensile and compressive reinforcement was used in all the beams, the percentage of reinforcement in the main girders being exceptionally high, on account of the small area available in the compression flange.

The bridge was tested with a dead load of 1 cwt. per square foot and a rolling load of two 16-ton traction engines each drawing a lorry loaded with pig-iron to a weight of 32 tons, or a total moving load of 96 tons. In all cases the recovery was complete after the load was removed.

The working stresses were limited to 700 lbs. per square inch

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maximum compressive stress on the concrete, and 16,000 lbs. per square inch tensile stress on the reinforcement.

The actual cost of the work as carried out in reinforced concrete amounted to £5,917. The estimated cost of a similar structure in steel and masonry was £8,390.

Reinforced-Concrete Bridge carrying New Road and Tramway over the Grimsby District Light Railway.—This bridge, also designed on the Hennebique system, consists of a roadway 40 ft. wide extending over two spans of 37 ft. 2 in. and 31 ft. 2 in. respectively. There are five main longitudinal beams, the two outer of which also carry a reinforced parapet. The parapets, however, are not designed to take any portion of the load stresses.

Between these main beams cross-beams are arranged, which support reinforced decking.

The percentage of reinforcement ranges from 0·60 per cent. in the cross-beams, to 4·67 per cent. in the outer main beams of the longer span.

The bridge was tested with two moving tramcars, and no appreciable deflection was recorded on any of the beams.

It was designed to allow for the passage of two 40-ton boiler trollies drawn by a 15-ton traction engine, that portion of the bridge not covered by the moving loads being loaded with 1 cwt. per square foot.

In computing the stresses, the various members were taken as being freely supported, and no allowance was made for the continuity of the beams or for the fixity of the ends, the allowable working stresses being the same as in the case of the previous bridge.

The actual cost of this bridge carried out in reinforced concrete was £2,939. The estimated cost of a similar structure in steelwork and masonry was £3,500.

Four High-Level Railway Bridges, Immingham Dock.—These are all skew spans of the same construction. Each bridge carrying four tracks over a siding for empty wagons, and forming practically a tunnel 86 ft. long.

The square span between the abutments is 15 ft. Both the wing walls and abutments are reinforced, and there are in addition reinforced tie-beams at the bottom of the abutments, at the same spacing as the cross-girders, embedded in a concrete raft.

The bridges were designed to carry axle loads of 18 tons, spaced 6 ft. 6 in. apart, or 72 tons on the single-line span.

The average cost of these bridges in reinforced concrete was £3,024 each. The estimated cost of a similar structure in steelwork and masonry was £3,800 each.

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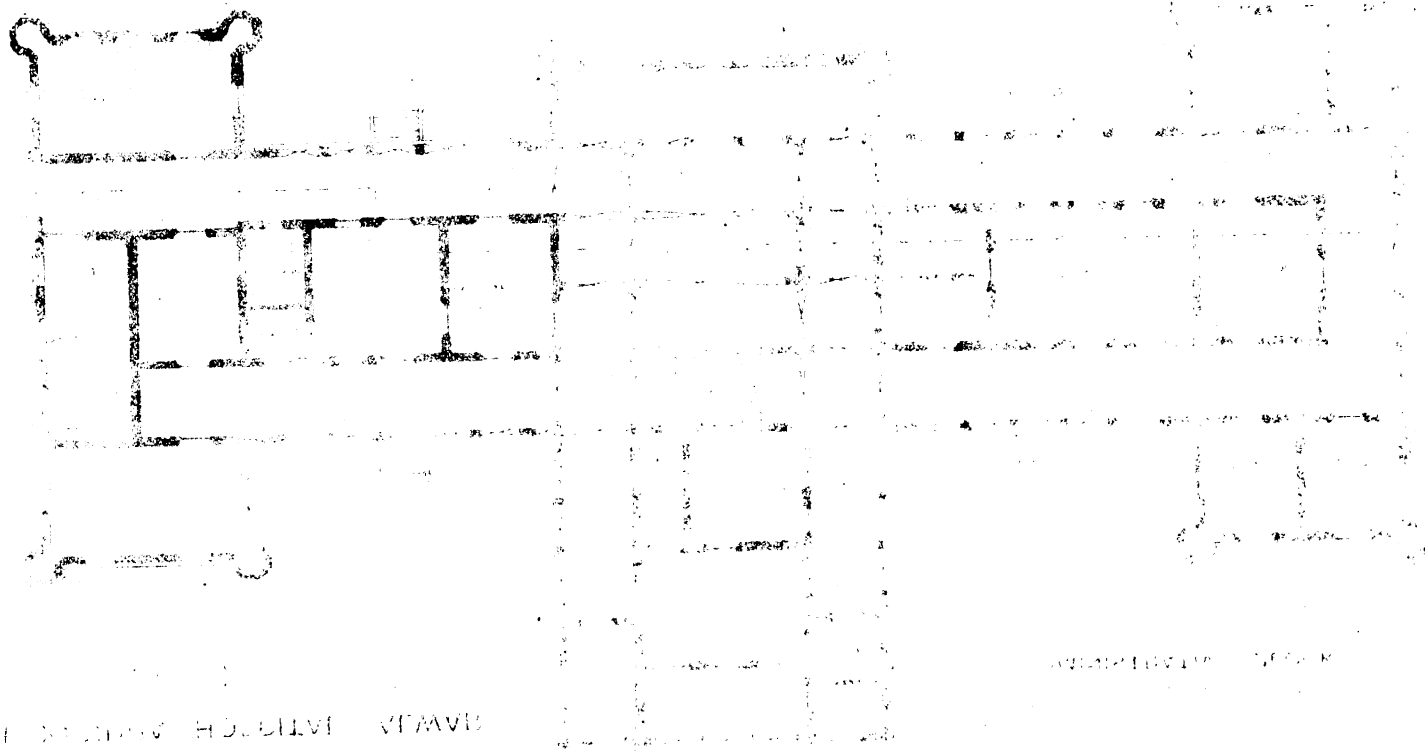

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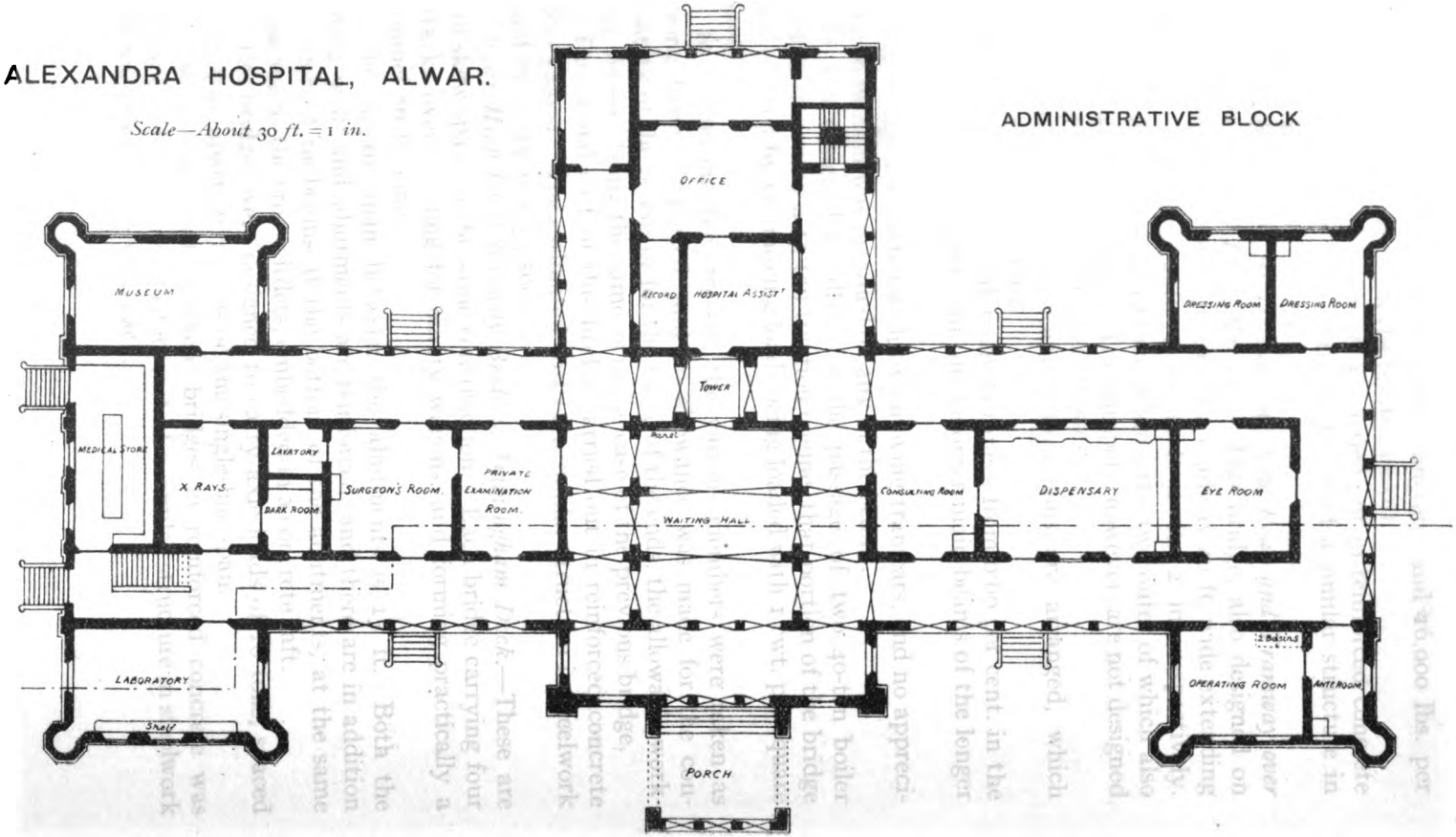
ALEXANDRA HOSPITAL, ALWAR.

Scale—About 30 ft. = 1 in.



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THE ALEXANDRA HOSPITAL, ALWAR.

By MAJOR A. ff. GARRETT, R.E.

IT probably does not often fall to the lot of an R.E. officer to be given a perfectly free hand practically regardless of cost as regards the architectural treatment of the buildings he erects, so possibly the following account of the new hospital in the Alwar State of Rajputana, which was built under these conditions, may be of interest to the Corps.

Early in the cold weather of 1904 there was a rumour that H.R.H. the Prince of Wales would visit India during the next year, and it at once occurred to the young Maharaja of Alwar, who had only a few months ago entered on his powers as ruling chief, to invite the Prince to Alwar and request him to open a new hospital, which he proposed to call the Alexandra Hospital after the Queen. Accordingly in my then capacity of State Engineer, I was asked to erect a wonderful and magnificent structure of pure white marble, and to have it ready within nine months, so that there might be a big opening ceremony in the winter of 1905, which would give the young Maharaja an opportunity of welcoming His Royal Highness to his capital. On representing to him that it would be absolutely impossible to complete the construction in so short a time, and that the cost would also be prohibitive, the Maharaja asked me to get out the design of a less pretentious, but more useful edifice, as quickly as I could, and press on with the construction with all speed. The matter was discussed with Capt. Smith, I.M.S., the Civil Surgeon, and finally the plan shown in the plan was adopted for the Administrative Block, the main operating room, and wards being arranged in separate buildings behind the main building. In designing the plan of the Administrative Block, the main idea was to enable out-patients to be dealt with rapidly, to prevent them from wandering all over the buildings, and to arrange the communications as conveniently as possible. Thus the out-patients enter through the front porch into the waiting hall—pass one by one into the consulting room to the right, and then along the back verandah past the dispensary windows, where they get their medicines, and any cases which require surgical dressing are treated in the two dressing rooms on the extreme right of the building. Similarly eye cases are examined in the eye room, and cases which require small and

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unimportant operations are dealt with in the operating room. The out-patients pass right away out of the building from the verandah on the right wing. On the left of the building are situated the surgeon's room and X-ray room, laboratory with large windows facing north so that direct sunlight is excluded, and a museum for surgical specimens, etc. Under the whole of the left wing are arranged cellars communicating with the front verandah by a flight of stone steps. These cellars serve as a supplementary medical store, and are very useful for storing packing cases and other such articles which would block up the medical store room and look very unsightly. These cellars are lit by small windows placed between the plinth and the ground. These can be seen on the elevation. Immediately behind the waiting hall are placed the hospital assistants' rooms, the offices and record rooms.

The Maharaja naturally desired an Indian style of architecture, and I accordingly took the plan to Sir Swinton Jacob's head draftsman, who supplied a small scale drawing of the front elevation. This with a few small alterations was adhered to, and the wards and other buildings were designed in the same style. In working out the details, Sir Swinton Jacob's *Portfolio of Architectural Details* was found extremely useful, though a considerable number of the details and carvings were worked out on the spot during construction. The hospital is built of a light grey stone, with facings of the well-known Agra and Delhi red sandstone. This forms a very pleasing colour contrast, and the pillars, cornices and brackets show up to the best advantage. The domes are of white marble with red sandstone bases. The balustrades in the verandahs, and the perforated tracery in the verandah arches, are carved from large slabs of the red sandstone. For this tracery work a large number of different designs were obtained, as also for the carving on the bases and caps of the verandah pillars. Competitions were held amongst the workmen, and small prizes given for the best designs. When a design was selected, a full size model was usually made in mud plaster, which enabled one to judge very well of the general effect. The model was altered until the result was found to be satisfactory, and the stone cutters were then put to work to carve the stone direct from the model. I was fortunate in obtaining a gang of 60 or 70 expert stone cutters from the neighbourhood of Delhi and Agra. These men took the keenest interest in the work, and displayed considerable originality in many of the designs which they proposed. Occasionally they made absurd mistakes, as in the case when one of them designed a bit of elaborate carving of vine leaves and grapes, in which the grapes were supported by the stalk instead of hanging freely. But such errors were easily eliminated in the mud modelling.

The roof is supported on ordinary rolled steel beams spaced 3 to 5 ft. apart. On the lower flanges of these were placed sandstone

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slabs, readily obtainable in the neighbourhood. Over these a 5-in. layer of "Kharanja" masonry and on top of this again 4-in. lime concrete. The "Kharanja" masonry is, I believe, a device peculiar to Rajputana. It consists of 4 or 5-in. flattish chips of stone laid in lime mortar directly over the slabs in a circular formation, so as to make a kind of flat dome. It serves to strengthen the slabs and to prevent their being broken by the subsequent ramming of the concrete. Over the concrete is a layer of "Kara" plaster, made of stone lime and crushed quartz. This is a pure white plaster, which when well laid, is found to be very durable and waterproof. There is always a risk of leakage in these flat roofs unless great care is taken with the concrete and plaster. The concrete must be rich in mortar, and well beaten until the mortar rises to the top. It is then finished off by gentle beating with wooden "Thapis" and the kara laid on. It is necessary to give a slope to the roof so that rain water may run off quickly.

A somewhat peculiar feature of the roof of the Administrative Block is the entire absence of the usual clerestory windows. In place of these, skylights were arranged. They are shown in rectangular dotted lines on the plan. There are two in the dispensary. They are made so as to open and are provided with long projecting eaves of sandstone slabs, so as to keep out direct sunshine and rain.

The floor of the waiting room is made of slabs of red, white and black marble, highly polished and arranged in geometrical patterns, while the pillars are of white marble with elaborately carved caps and bases. The floors of the operating and dressing rooms are made of large slabs of polished white marble with a slope draining off into drains and sumps arranged outside the building. All this marble was obtained from local quarries in the Alwar State. The floors of the other rooms are of lime concrete covered with white chunam plaster. This latter is really kara plaster highly polished by a somewhat technical and laborious process more or less peculiar to Rajputana. It gives a very hard durable surface almost like marble. The verandah floors are paved. All corners and edges are rounded off throughout the whole hospital, so as to avoid cracks in which dust could lodge, and the walls are all covered with a washable sanitary distemper. In the operating rooms, the walls are of polished marble up to a height of 6 ft.

The main operating room is in a separate building behind the Administrative Block. It has a large window of plate glass facing north, so as always to exclude sunlight. The operating room is connected with the surgical ward by a covered passage, so that after an operation, a patient may be wheeled directly into the ward.

There are separate wards for women's cases, fever cases and miscellaneous, each ward containing 11 beds.

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The latrines are outside and at the back and connected with the wards by covered passages. There is also a ward for infectious cases in a separate and isolated part of the hospital compound. There are also various staff quarters for assistant surgeons, hospital assistant, dressers and menials.

It is intended to eventually add an electric light installation and to lay out all the spaces between the wards as gardens.

Work was begun towards the end of 1904 and vigorously pushed, but when it was heard that the Prince of Wales was not actually going to visit India at all the allotments were considerably reduced, and the work consequently dragged considerably, and it was only opened by the Viceroy, Lord Minto, in 1909. The construction thus occupied nearly five years.

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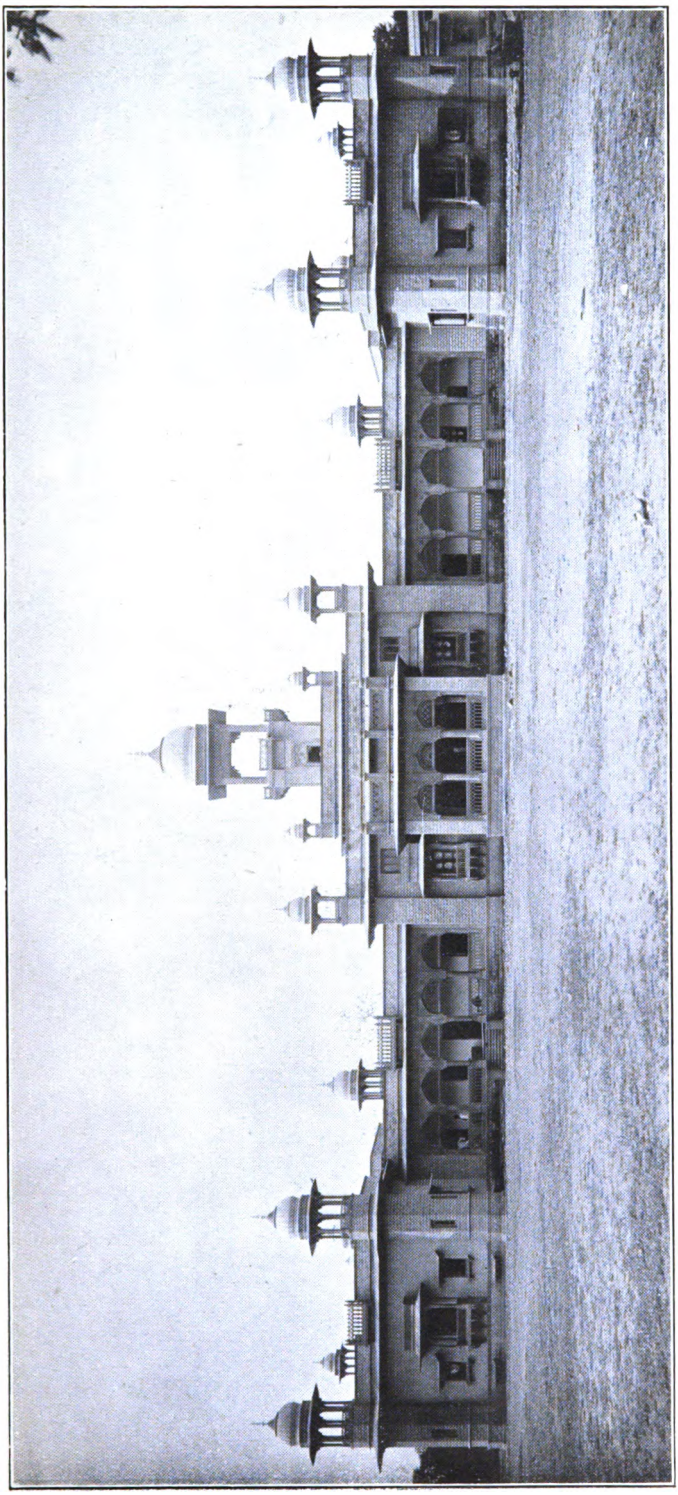
ALEXANDRA HOSPITAL, ALWAR.



Front Elevation.

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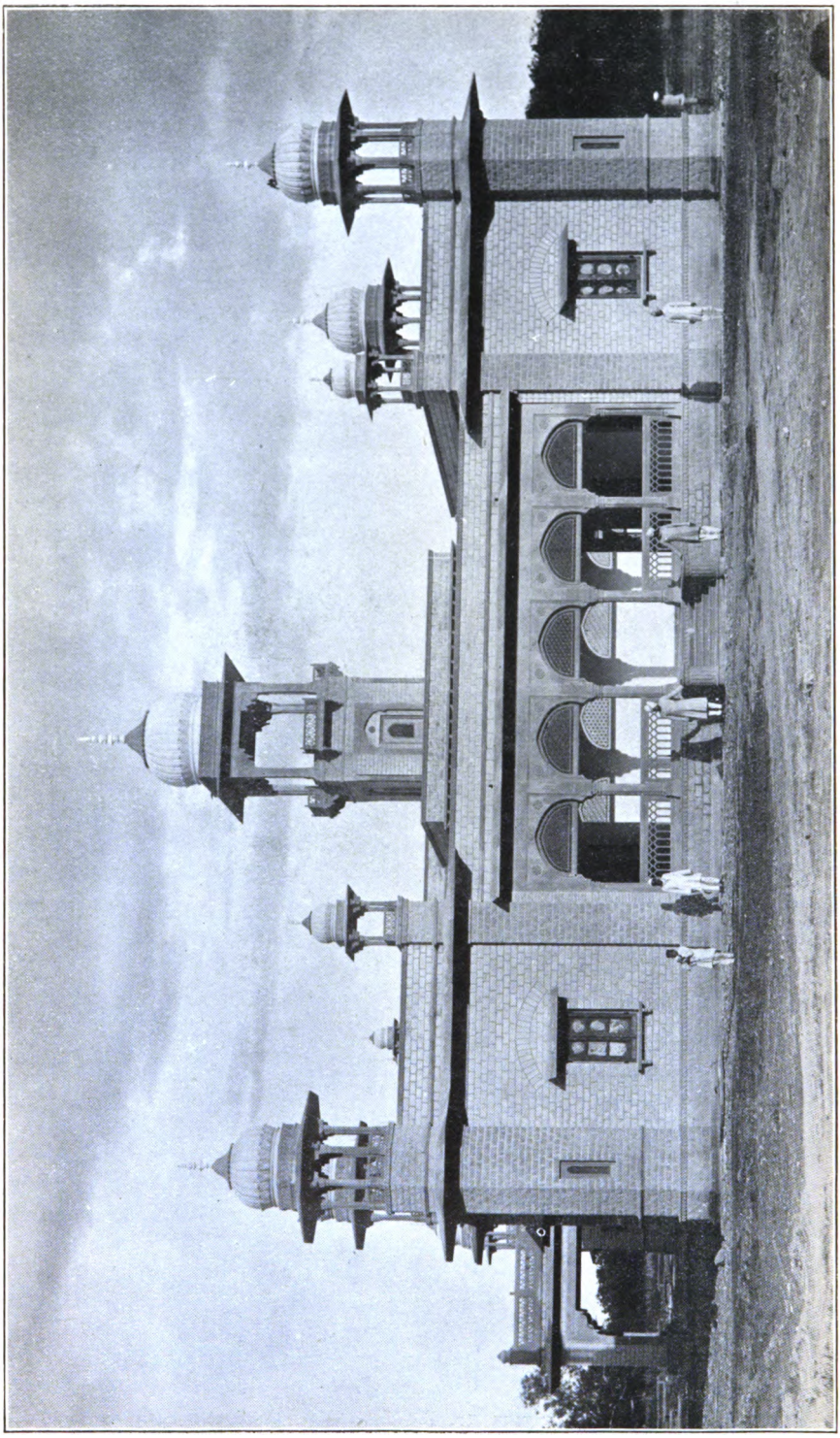
ALEXANDRA HOSPITAL, ALWAR.



Right Wing.

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REVIEW.

A TEXT BOOK OF MILITARY HYGIENE AND SANITATION.

By LIEUT.-COLONEL F. R. KEEFER, M.D., Medical Corps, U.S.A.

THIS small book of some 250 pages surveys in a brief compass the whole range of military hygiene, including such questions as physical training, clothing, equipment, food, water supply, accommodation both on land and sea, diseases and their prevention, etc., etc.

The subjects dealt with are treated in a simple manner, suited to the general reader or regimental officer, and is not intended for experts. A great mass of useful information is condensed in a small space, and among items of interest is the following extract from p. 101 :—

"Only two armies other than our own issue socks to their soldiers. These are Great Britain and Japan. The great military nations of the European Continent expect their men to provide themselves somehow with these articles, which by us are deemed of such importance. From motives of economy many German soldiers wrap oil-soaked cloths about their feet in lieu of socks."

It would be of interest to know what our enemies and allies on the Continent of Europe are doing at this time about the provision of socks!

The price of the book is not stated, it is worth perusal by all interested in the subject.

H.B.

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NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

July—August, 1914.

OPERATIONS FOR THE PASSAGE OF UNFORDABLE RIVERS.

During the course of operations in war it frequently becomes necessary for large masses of men to force a passage across unfordable rivers, the passage being contested by the enemy. Such a crossing may happen under very different conditions, depending essentially on the characteristics of the rivers, on the formation of the ground near the river banks, on the strength of the detachments which are required to cross, as well as on the opposition that is likely to be made to the passage.

The considerations for selecting the points for forcing a passage across a river may be summed up under the following headings :—

(*a*). To select in the first place the position for the principal passage, and also for secondary crossings at other points so as to distract the attention and the forces of the defender, and so to facilitate the main passage.

(*b*). To pass across to the opposite bank, by means of rafts, boats, or pontoons a certain force of infantry required to hold the bridgehead.

(*c*). To construct the bridges in the positions before selected.

(*d*). To effect the crossing of the great columns by these bridges.

With the assistance of maps the ground on the banks of the rivers which it is intended to cross by force should be thoroughly studied, and the positions fixed for the construction of the bridge.

It is advisable to select positions for the bridges where the river is at its least width, and flows in a concave direction to the defence because the positions on the flanks of the attack are not so exposed to the enfilading fire of the defenders, and where the ground does not offer obstacles, such as marshes, watercourses, or canals, which would serve to impede the movements of the troops after crossing.

The secondary operations for the passage should be carried out on places where it is known or assumed that the defence is weak or absent, and these are then favourable to the success of the principal crossing because offensive action can be taken on the flanks of the defenders.

It is necessary however to bear in mind that secondary operations are frequently the cause of complications in the main operations of the crossing, and grave crises may occur when small detachments remain

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isolated for a time on the same bank as the defenders. The principal objects for exploration and reconnaissance are

(*a*). The width of the rivers at the spots proposed for the crossing.

(*b*). The particulars of the defensive occupation near the banks; the position of the artillery and mitrailleuses, the eventual commencement of a movement in retreat or the movements of reinforcements.

(*c*). The location of searchlights or means of nocturnal illumination.

(*d*). Watching those parts of the river that by their situation and by the nature of the banks would aid counter-offensive crossings by the defenders; great vigilance should also be shown in watching the fortresses or bridgeheads situated in the vicinity.

Operations for the Passage.

For these it is especially necessary to transport to near the principal point of crossing not only the floating material strictly necessary, but also a sufficient reserve to replace any of the boats or pontoons that the enemy may be able to sink. These reserve materials should be placed at a little distance from the points of crossing in such a way that they can be easily utilized. It is a good rule to divide the material uniformly on the various selected points; and especially to have at each point bodies of infantry equally strong, and to avoid losses or damage from the defenders' artillery fire to large masses of materials which have a tendency to be collected on favourable spots on the river bank. It is also necessary to avoid as much as possible the noise caused by the approach of the carts and materials to the river bank, and the throwing of the spars, chesses, etc., into the water.

The execution of the bridging operations requires promptness and punctuality by all the troops engaged, especially on the part of the engineers who with their proper equipment should be able to overcome difficulties and prevent friction. The commander should calculate the time, allowing ample time, so that the more delicate operations of loading and placing the boats in position in the water may proceed without undue haste, and on the other hand that the operations should not be too prolonged, so that the energies of the troops may be saved, and that there may be fewer risks of being discovered.

Night-time is preferable in some ways for the actual construction of the bridges, notwithstanding the difficulties that have to be overcome, because the defenders are not so active with their fire and counter-attacks as in the day. Misty weather is also favourable for all bridging operations without having the inconveniences of the night.

The opening of fire during the bridging operations at the opportune moment is of particular importance for the artillery. The guns of the attack which have not yet entered into action tend definitely to veil the intentions of the attack and the localities of the bridging and on opening fire disclose the secrecy of the operations. The opening of the artillery fire is a delicate question which can be left to the commander of the troops who will commence the fire accordingly as the formation of the bridgehead will meet serious opposition from the defenders on the opposite bank, or the reverse.

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Compilation of Orders.

Another important question of the operations is the compilation of orders.

The commander, during the course of the reconnaissances after having disposed the troops, the technical detachments, and the materials provisionally, by aid of the map should be able to compile a draft of the various necessary orders. These should be definite and framed from the results of the explorations and reconnaissances.

The orders once given, it is not advisable to communicate them to the executive commands too long before their execution, as a sudden change of the situation may require alteration.

As regards the secondary crossings or feints of crossing, and the actual construction of the bridges, it is advisable that the superior commander should limit his instructions as far as possible, assigning the necessary material to the officers charged with the construction of the bridges.

The engineer troops required for the bridge construction should be drawn from the great unit of which they form part and from which they are assigned to the charge of the operations just for the time. It is also advisable to assign to the executive officers of the various operations, as guides, the heads of the patrols who have completed the most interesting and valuable reconnaissances in the direction of each operation.

The orders should be as brief as possible and should comprise (after explaining the preliminary indications and the general character of the work) all the instructions necessary for the completion of the work by the executive officer.

If there is time, it may be as well to add a sketch showing the indications contained in the writing in order to make the orders and instructions more clear. This is of importance in regard to the lines of communication and for the references to the network of roads, and for the various dispositions relating to the passage of the river in question.

September, 1914.

MILITARY OPERATIONS FOR THE CROSSING OF UNFORDABLE RIVERS.

The article on the above heading which appeared in the *Rivista* for July—August is continued in the number for September with an historic example of the passage of the Limmat, by the French under Massena in 1799, which among numerous examples offered by military history appears to be one of the most instructive.

Passage of the Limmat to Dietikon (25th September, 1799).

The Archduke Charles evacuated Switzerland at the end of August, leaving Hotze with 17,000 Austrians, and Korsakow with about 31,000 Russians, altogether 48,000 Allies against 60,000 French under Massena. Suwarow, not being able to rejoin the new theatre of operations until the latter half of September, sent orders to Hotze and Korsakow to wait in their respective positions until his arrival (announced for the 26th September in Altdorf) in order then to commence a concentric movement against Massena. Massena had however decided to attack Korsakow and Hotze before Suwarow's arrival, with the greater part of

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his force, and with the divisions Mortier, Lorges, Mesnard (37,000 men) crossed the Limmat and defeated Korsakow, and with Soult's Division and Moliton's Brigade (about 13,000 men) at the same time attacked Hotze in the valley of the Linth, in order to prevent him from hastening to Korsakow's assistance.

The Limmat from the Lake of Zurich up to its junction with the Aar formed a considerable obstacle, not so much for its width (from 100 to 150 m.) as for the great velocity of the current, the depth of the channel, and its rocky bed. Massena had taken two points of crossing into his consideration; one near Dietikon, the other near Höngg. Massena decided on the first, distant only 10 to 12 k.m. from Zurich, since it offered the possibility of breaking the enemy's lines and marching on Zurich, so as to fight with Korsakow.

The Limmat, near Dietikon, forms a loop convex towards the west, dominated by the left bank. The level ground near Urdorf stretches widely to the river, offering a good position for artillery, and covered from the view of the enemy's troops posted to the south of it. The width of the river is from 90 to 100 m., the velocity of the current is considerably less than in the mountains. The depth, also, offers a better anchorage than in other places. The left bank is covered with vegetation, and the village of Dietikon which rises in the immediate vicinity of the bank permits of the crossing being undertaken outside the view of the enemy. The right bank was also woody, and without communications leading to the river, was occupied by the Russian advanced posts. At the distance of 6—8 k.m., a hilly tract offered a good defensive position to the Russians (Markow's detachment, 1,800 men, 400 cavalry and 7 guns). On the left bank good roads coming from Baden, Bremgarten, and Zurich lead to Dietikon. The roads from Zurich it may be noted ran near to the point of crossing, at about 40 or 50 m. from the left bank of the river. On the right bank only a footpath intersected the roads, Zurich-Oetwil-Baden.

Massena, with the Lorges Division and half of Mesnard's Division (15,000 men), crossed the Limmat near Dietikon, driving back towards Zurich the Russian troops that he found on the right bank of the river, and marched on that town. The remaining half of Mesnard's Division (4,000 men) at the same time effected the passage of the Aar near Stilli (at its confluence with the Limmat) to deal with the Russian forces. Mortier's Division attacked in the direction of Wiedikon, the Russian forces of Korsakow, so as to deal with them with the assistance of Klein's Cavalry Division. The corps of General Humbert was in reserve at Albierieden to assist Mortier at Lorges.

The direction of all the technical preparations was entrusted to General Dedon, who had at his disposal 5 companies of pontooneers. From these one was sent to Soult for the passage of the Linth, and one to Mesnard for a demonstration near Stilli; there remained 3 companies for the crossing at Dietikon. A bridging detachment was at this time at work on the Reuss near Rottenswil. A depôt of boats was formed near Brugg, on the Aar. Detachments of sappers were added to each unit of the troops.

The principal difficulty consisted in placing the bridging material

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(near Dietikon) for the bridge at that point. The larger embarkations, too heavy for the transport wagons, were sent by water to Stilli, for the pretended passage. The smaller embarkations (sufficient for 900 men) were sent to Dietikon not by the road Brugg-Baden-Dietikon, which was too much exposed to the enemy's view, but by the ordinary road to Bremgarten whence they proceeded in company with the detachments coming from Rottenswil. These last to avoid suspicion were located along the Reuss only 24 hours before the crossing. The passage was effected partly by day and partly by night, and the convoy without the knowledge of the Russians was able to go to Dietikon at 1,500 paces from the bank, and to be united under cover. From this position, on the night of the crossing, the material was carried and escorted by infantry up to the river, it not being thought advisable to employ quadrupeds at such a short distance from the lines of observation of the Russians. In order further to deceive the enemy several demonstrations were made towards the confluence of the Reuss with the Aar.

Whilst on the 19th September, Massena in Bremgarten communicated to his generals the order to effect the crossing on the 26th, the Allies decided on the same day a general attack on the French positions. Massena becoming aware of this intention ordered the arrangements to be put into action at dawn on the 25th. Mesnard commenced the feigned crossing at 5 o'clock on the 25th, opening a heavy artillery fire against the enemy's positions on the opposite side of the Limmat, and ordering some companies to cross the Aar at the valley at its confluence with the Limmat. These after crossing, quickly constructed a small bridgehead near Vogelsang, under the protection of which they threw across a flying bridge. The three battalions at Mesnard's disposal were spread at wide intervals south of Stilli on the left banks of the Aar and the Limmat from whence they opened a sharp fire against the enemy's positions. This demonstration deceived Durasow who abandoned to itself Markow's Detachment at Dietikon and although within hearing of the guns took himself towards Frendenan. Becoming aware in the afternoon that he had been deceived he re-ascended the river with the greater part of his forces, but without result.

On the night of the 24th—25th September the 15,000 men of Lorges were assembled near Urdorf. General Dedon who assumed the direction of the crossing at first placed in battery 32 pieces of various calibre at the loop of the river, so as to bring a crushing fire on all the ground that they overlooked, dominating at the same time the right bank and so preventing the arrival of reinforcements. He systematized the crossing by sending 900 men who were ordered to approach on three different points, and with three groups of boats or pontoons. All the boats were transported at night by the pontooneers and infantry to the river bank.

Detachments of sappers stationed at each of the points of crossing executed the necessary works for facilitating the embarkation and disembarkation. All the preparations were made by midnight, the Cossacks who usually kept an active watch had seen nothing. At 4.40 Dedon gave the signal to throw the boats into the water. The operation proceeded very carefully, but the noise of the oars gave the alarm to the Russian advanced posts who opened fire. The operations were then

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accelerated, and 300 men were able to approach the island in front of Dietikon and 600 on the opposite bank. The Russian advanced posts were badly placed for the defence, and the troops advanced assailing the Russian encampment while the French artillery rendered the defence on the enemy's bank unsustainable.

The Russian artillery at the first alarm had opened fire in the direction of the point of crossing, but with slight effect. After that the first orders for the crossing had been carried out without notable resistance Dedon ordered the artillery fire to be suspended, so that the crossing might be continued expeditiously.

The time for completing the embarkation for the passage of the river, for the disembarkation, and the return of the empty boats was not more than 10 minutes.

After the order for the second disembarkation, Dedon considered the success as assured, and gave orders to throw the bridge across the river. The crews and the equipment for the bridge were advanced from Dietikon and at 5 o'clock they commenced the work of constructing the bridge, whilst at the same time detachments of sappers prepared a passage through the woods to enable the artillery to advance to Kloster Fahr, after crossing the bridge.

The pontooneers had to contend against a strong current and difficult anchorage. The bridge, 100 metres in length, was finished by 7.30. At this time 8,000 French had crossed to the right bank; the remaining detachments of the divisions of Lorges and Mesnard (about 7,000 men) the greater part artillery and cavalry passed by the bridge. At about 9 o'clock the entire French corps had completed the passage.

E. T. THACKERAY.

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RECENT PUBLICATIONS OF MILITARY INTEREST.

REVIEW OF BOOKS.

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LAW.

AIRCRAFT IN WAR. By J. M. Spaight, LL.D. 172 pp. 8vo. London, 1914. Macmillan & Co. 6s.

In the opening part of this book the war right of aerial bombardment is treated at some length. The author takes as his text the very interesting lecture delivered at the Royal United Services Institution last April by Colonel L. Jackson, R.E., who raised the question of London's liability to attack by a hostile airship fleet. The author's conclusion is that the terms of the Hague *Réglement* for war on land, which exempts *undefended* cities from bombardment "by any means whatever," is not a sufficient international guarantee of London's security, and he quotes authorities, including German and British official manuals, to support his view.

To some extent the book is simply an expansion of the article entitled "War Law for Aircraft," which appeared in *The Army Review* for April, 1914. Some of the questions which were briefly dealt with in that article are treated in the book at greater length. An example is the question of attacks on raiding enemy aircraft by non-military populations. In the article, only the case of aircraft detached from an army which has invaded some portion of the opposed country was discussed. The equally conceivable case of raids carried out by airmen whose army has not yet set foot in the raided country is dealt with in the book. In the book many questions are more fully discussed than in the article and several new ones besides. Among the former is the question of neutral atmosphere. This is of especial interest to England for a foe coming to attack her from middle Europe would find his shortest air route lying over Belgium and Holland. The former is a neutralized country. The latter would probably be neutral in a war of the Great Powers. One assumes, of course, for this purpose that England's enemy is a State which respects treaties and has some regard for its honour and its bond; not always a safe assumption, as recent events have proved, but the world is being cleansed as these words are being written.

In one case the author has discarded in the book a view which he adopted in the article. He no longer thinks the *Alabama* rule can be applied to aircraft. The practical difficulties in the way seem to him, on reconsideration, too great.

Other questions are more fully discussed than in the article; for instance, that of the treatment of private enemy airmen who are captured. Dr. Spaight disagrees on this point with continental writers who hold that they should not be considered prisoners of war.

The question of contraband of war with regard to aircraft and their parts, and that of private enemy aircraft in enemy's territory on the outbreak of war, are also discussed.

The appendices contain codes proposed by MM. Fauchille, D'Hooghe, Le Moyne, von Bar, and the author.

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The author's code contains some new features not hitherto suggested. These are :—

(1) an insistence on the necessity for uniform for pilots ;
(2) recognition of military necessity as justifying the shelling of civilian aircraft in practically any circumstances ;
(3) a simpler and yet more comprehensive view of what constitutes aerial espionage ;
(4) a provision that air bombardment must in all cases be authorized by the general or admiral in command ;
(5) a proposal that, though, for belligerent aircraft passage through neutral atmosphere and entry of neutral ports are strictly forbidden, an exception should be made in the latter case in favour of seaplanes attached to a fleet so long as they remain in actual contact therewith.

These and other new suggestions are discussed at some length. Dr. Spaight has supplied a basis from which any discussion of international law as applied to aircraft must proceed. Many points demand some definite ruling. Fighting aircraft has beyond all question come to stay—as the author points out ordinary rules cannot govern them since land and maritime law differ and yet the same type of aeroplane might be attached either to an army or a fleet.

STRATEGY, TACTICS AND TRAINING.

THE OPERATIONS OF SMALL FORMATIONS IN THE OFFENSIVE. (Étude sur la conduite des petites unités dans l'offensive). By Capt. C. Barberot. Part I., Evolutions, Approach Marches, Combat. 104 pp. Plates. Paris, 1913. Lavauzelle. 1s.

In a preface the author justifies the publication of his work. From a *régime* of stereotyped company and battalion evolutions "lightened up at times by a little guerilla warfare" the French Army has since 1904—according to him—gone to the opposite extreme. The preaching of "initiative" and of "reason as opposed to rote" brought "liberty too suddenly to slaves." The development of higher studies caused many to despise the details of handling small units. "Ideas" for all evolutions prevented "step by step" instruction. Application of knowledge preceded the acquiring of it. Russian and Japanese officers fresh from Manchuria who saw the French Army said : "You are too apt to consider small bodies as acting independently." The author assures his younger comrades that close attention to details of leading small units will call for talents and judgment quite equal to that which they may be required to display in the course of larger manœuvres.

The author treats separately :—

Evolutions whilst troops are in the hands of their commanders and can manœuvre.

Approach Marches when they are committed to a definite task, and retain only limited manœuvring powers.

The *Combat*—when they use their arms.

Treating of evolutions the author regrets that the French regulations do not draw a clearer distinction between parade movements (designated merely to inculcate passive obedience) and evolutions properly so called. For the practice of the former he thinks a definite time limit should be laid down, but correct commands, etc., should be strictly insisted on. For the directing of evolutions he considers absence of noise and use of signals to be essential. He emphasizes the importance of commanders not remaining glued to their units.

Approach marches are dealt with at considerable length. The author considers them to be profoundly modified by the offensive strategy (marching quickly towards enemy on a broad front) recently adopted in France, and by the advent of aeroplanes. They largely concern regimental officers and are much more difficult than is generally supposed, offensive movements signifying a narrower frontage for units, will limit opportunities for utilizing covered approaches. Later on (p. 51 *et seq.*) he points out that no well-defined line separates "evolutions" and "approach marches," even units of a battalion may change from one to the other according to the exposure

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of the ground over which they pass. Considering formations from the point of view of avoiding losses, he points out that in approach marches, formations—even in the case of sub-units of the smaller commands—will vary according to the intensity and nature of the fire directed at them, *e.g.*, the head of a semi-deployed unit may form columns smaller than the rear portion. Hence the great importance of the platoon commander's *rôle*. Sketches on p. 39 show various formations which a battalion might adopt during an approach march. Proceeding to consider the question from the point of view of the facility for manœuvring he lays down certain principles :—

Direction.—Normally, every commander should, until prevented by hostile fire, keep near to a directing unit by which all subordinate units should march. Further, a commander should place himself so as to make his influence felt quickly at a critical moment, which generally means well to the front.

Pace.—The pace must depend upon the nature of the task to be carried out, and also upon the ground.

Intercommunication.—Communication must be kept from top to bottom, *vice versâ*, and laterally. Means for ensuring it, says the author, are insufficient. Six mounted scouts per battalion are required, he thinks, (a French regiment actually has twelve per regiment) one to each company, and two at battalion headquarters.

Reconnaissance.—All commanders must constantly get well to the front to ensure this. When thus leaving their units they must place points to guide these latter. For this purpose, and for showing to the artillery the positions of the infantry units, the author recommends the use of battalion flags (formerly carried in the French Army). For efficient reconnaissance he considers that infantry officers should remain mounted as long as possible, and deplores the haste to dismount shown at peace exercises, " an isolated horseman is not easy to hit even at 900 yards ; our men will begin to think that we value our skins unduly."

Security.—All units near the head of a formation should cover themselves by patrols pushed to points within rifle range : this signifies a distance varying according to the ground, but 600 to 800 yards will generally constitute the limit to which these protective patrols could go.

Coming to the combat he emphasizes the importance of putting into the firing line the smallest possible number of rifles, since fire impedes movement, except in cases where the situation demands a vigorous initial effort. He discusses also the advisability of limiting the number of rounds to be fired at each burst, and thinks that this should, generally speaking, be done when covering short movements. For fire control he recommends numbering certain " description points," a system which appears less practical than the designation of such points contemplated in our regulations. He discusses the size of units by which advances should be made and the formations to be adopted. By a sketch map on p. 68 he illustrates his view that this is entirely a question of ground.

MILITARY EDUCATION IN THE UNITED STATES. By Capt. Ira L. Reeves, U.S. Army. 431 pp. 8vo. Burlington, U.S.A., 1914. Free Press Printing Co. 7s. 11d.

This is a book which undoubtedly will fill a gap in the library of anyone interested in military education. In addition to chapters on West Point and the various Army Service Schools (which range from the Army War College to the School for Bakers and Cooks) there are sections on military education in civil institutions of learning and in Land Grant Colleges and Universities. Not the least interesting part of the book is to be found in the pages devoted to specimen examination questions for entrance to the Military Academy : it is gratifying to find in the question " what are the most important facts about the life and works of anyone of the following authors " that, of the six authors given, five are English, Burns, Milton, Keats, Tennyson and Dickens ; the many admirers in this country of the author of *Tales of Mystery and Imagination* (who was by the way a student at West Point) will be delighted to find that he is the remaining writer in the list.

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RUSSIAN REGULATIONS FOR THE INFANTRY COMBAT. Official. 77 pp. 8vo. St. Petersburg, 1914.

This manual, issued for the first time, forms a counterpart to Part IV. of our Infantry Training. The latest Russian *Field Service Regulations*, which appeared in 1912, are being supplemented with brief manuals for each arm. That under review is the second to appear, *Regulations for the Action of Artillery in the Combat* having been issued in 1912.

Manuals of tactics issued by an army which has had late experience of a great war, and which is making a great effort to remedy the defects discovered by that war, have naturally a special interest. The chief defects of the Russian infantry in Manchuria may be said to have been dense and antiquated formations unsuited to modern warfare, bayonet attacks with insufficient fire preparation, and lack of individual initiative and offensive spirit. The formations now laid down are in accordance with the general principles in practice in our own armies, but the impression given by a study of these regulations in comparison with our own Infantry Training is that, in their desire to cultivate the offensive spirit at all costs, the Russians have neglected to emphasize the necessity for preparation by fire before an assault. The words "superiority of fire" do not occur in the manual at all, and there is no indication of a systematic building up of the firing line to the requisite strength in order to obtain it.

A few quotations may serve to show the general tendencies of the manual :—

"The strength of infantry in battle lies in rifle and machine-gun fire combined with a resolute advance and bayonet charge." (Paragraph 2).

"Independently of the distance separating the two forces, the assault should commence at the moment when, according to the object in view, the situation, and the results already obtained, the time has come for the bayonet charge ; or when it is noticed that the enemy's *moral* is wavering." (Paragraph 82).

"The assault should be made not only on a weakened adversary, but on an adversary who still retains readiness to beat off the assault, if the situation demands it and if it is necessary to help some other portion of one's own force." (Paragraph 83).

"Infantry carries out the assault firing on the run from close distances ; before the bayonet attack hand grenades are thrown. If the enemy is surprised he should at once be attacked with the bayonet, without waiting to open fire." (Paragraph 87).

"If the assault fails, it should be repeated till the object in view is obtained." (Paragraph 92).

The signal for the assault will usually come by the action of some part of the firing line and should be supported by the remainder. Very considerable individual initiative in this respect is encouraged thus in the section on the counter-attack in defence :—

"The attack of a company should be supported by neighbouring units without awaiting special orders from the higher commander." (Paragraph 127).

"On occasions the general counter-attack of the battalion may take place by the necessity to support one of its companies which has attacked on its own initiative." (Paragraph 163).

Generally, in the defence, no clear line is laid down between the local and general counter-attack.

A few other points of interest may be briefly noted :—

(*a*). Position of commanders—"Every commander should be in the position from which he can best direct the units under him and if possible personally watch their action. . . . At critical moments he should be in such a position as directly to control the troops and inspire them by his personal example." It has been remarked on peace manœuvres that Russian battalion and regimental commanders are apt to be too far forward in action.

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(*b*). Very great stress is laid on detailing special parties or individuals for observation over the field of battle. It is laid down that every unit down to the company must always arrange for this.

(*c*). Volley firing may be used at long ranges at large and important targets to pursue a retreating enemy; to repulse a night attack; for ranging. In the firing line volleys should not be used by a larger body than a section.

(*d*). The length of a rush in the advance over open ground should average about 100 paces.

(*e*). The firing line entrenches, by order of the commanders in the firing line, when it is necessary to remain long on one fire position, or to secure a position won from the enemy.

The last three sections of the manual deal with the meeting of an attack by cavalry, night operations, and the use of searchlights. The principal injunction with regard to the former is that a cavalry attack should be met by fire in the formation in which infantry are at the time; any attempt to carry out complicated changes of formation will usually result in confusion. The section on night operations is brief but contains all the usually accepted principles. Searchlights are being widely adopted in the Russian Army and every infantry regiment will eventually be equipped with them. General principles only are laid down here.

Taken on the whole, these regulations are much briefer and more general than our own, which fact makes them a little difficult to criticize. No exception can be taken to any of the general principles laid down, but, as indicated above, the tendency seems to be to encourage offensive action to an extent that may possibly cause the neglect of fire preparation. Perhaps the Russian General Staff have embodied in this manual the ideas derived from a study of the tactics of their fellow Slavs in the Balkans. The present rank and file of the Russian Army have not, perhaps, reached such a high pitch of civilization as their neighbours. They should, therefore, be able to endure a heavier percentage of loss in order to get home with the bayonet. It is possible that the Russians in the desire to cultivate the offensive spirit, which is apparent in all their training manuals recently issued, are deliberately prepared to face the losses which may be incurred by premature assaults.

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THE POND SHEER BOOM.

WRITING from 408, Broadway Court, Winnipeg, Manitoba, Mr. Chas. A. Bramble, late Lieutenant, Royal Westmoreland Militia, says :—

I am venturing to call your attention to a device which as it seems to me might be useful in certain contingencies in the present operations on the Continent.

The Pond Sheer Boom was invented by a New Brunswick lumberman, in the early eighties, to steer his logs in a bay where they could be held. It is now in very general use wherever big lumbering operations are carried on in Canada or the United States. The St. John River is about the same width, I understand, as the Rhine, and I can speak from personal knowledge when I say this boom can be made to span the former stream in a few minutes—almost at right angles to the banks. The requirements for successful operation are sufficient water for the rudders to clear the bottom, and a moderate to swift current. My recollection of the St. John's rate of flow in summer is that it does not exceed 2 or 2½ miles an hour at Fredericton.

The boom, as made by lumbermen, usually consists of joints consisting of a couple of baulks of timber jointed together, but at a pinch almost any kind of timber will serve. The area of the rudders must be largely in excess of the immersed surface of the baulks, to obtain the " otter " effect.

The patent has, I believe, long expired. The joints are shackled with short lengths of chain. Such a boom could be speedily improvised provided rudders and chains were on hand.

The Pond Sheer Boom is described as follows :—

This provides a rapidly-constructed bridge over a river of almost any width, although it was not devised for that purpose. By varying the inclination of the rudders to the current, the joints, either individually or collectively, may be made to assume any angle with the bank, from parallel to almost a right angle.

As made by lumbermen it would not carry troops excepting in single file, but if constructed more substantially, might have very much greater carrying capacity.

The only iron work necessary are the rudder fittings, and the short lengths of chain to shackle the joints to one another, and these latter could be dispensed with for short service, and rope used instead.

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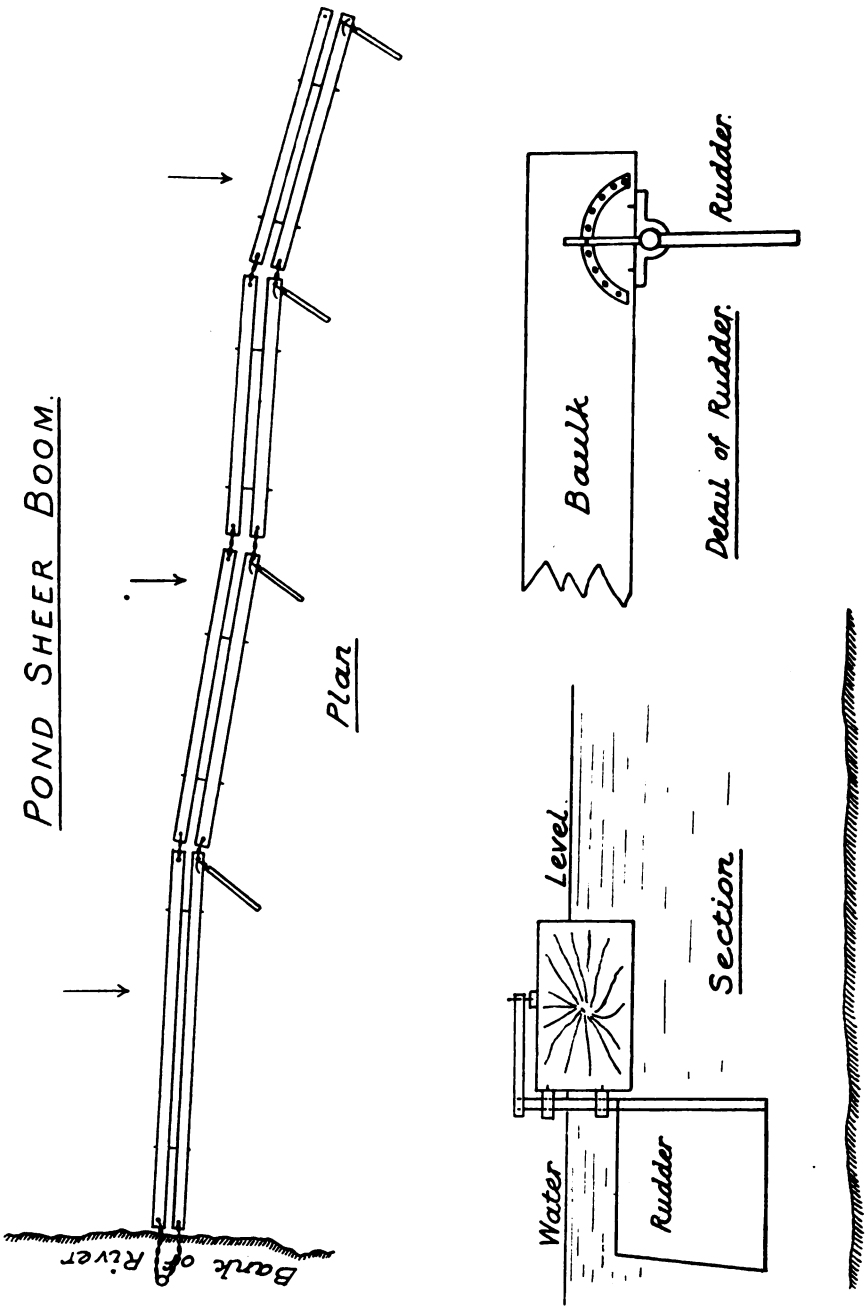
One of the booms will "walk" upstream in a perfectly wonderful way, and once in equilibrium, will remain at a large angle to the current, without further attention.



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ENGINEER TRAINING OF THE JAPANESE ARMY.

By the courtesy of the Japanese Military Attaché we have been enabled to reproduce extracts from the translation made by Capt. F. S. G. Piggott, R.E., of the above important work.

THE PRINCIPLES OF COMBAT AND ENGINEERING WORK.

Section 1.—General Principles.

1. Engineers generally carry out work demanding special technical skill, and great digging powers. Although infantry and artillery should themselves construct the works they require, the engineers should, according to circumstances, give them guidance or help, and on special occasions they may take charge of the work which the other branches of the Service should really carry out themselves.

2. Engineers are employed to the best advantage under a single control; by this means the engineer commander can himself dispose the *personnel*, tools, and stores of his whole force in a suitable manner, and can superintend accurately all the work. However, when control is difficult, on account of the tactical situation, the configuration of the ground, or the area of work, the engineers may be divided, and attached to other units. Even on these occasions, when the need for them is finished, it is essential that they should be immediately restored to the command of the engineer commander.

Engineers directing the work of another unit should usually be attached to that unit, and there are occasions when this may be done if they are merely assisting in the work.

When other units are detailed to assist the engineers, according to the situation, and, in particular, to the type of work, they should usually be placed under the direction of the officer commanding the engineers as regards the actual work.

3. The officer commanding engineers will usually be directly attached to the commander of the force; he will have the control of the whole, or greater part, of the engineers, and, from time to time, of other units; he takes charge of the work required during every phase of the battle.

Engineers attached to another unit carry out the work required for that unit during the progress of the action, exclusively, based

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upon the intentions of the commander of the unit to which they are attached.

When engineers direct the work of another unit, the officers will assist in connection with the plan, allotment, and actual carrying out of the work, while the N.C.O.'s and men will show the method and examples of the work. When engineers assist in the work, they will usually take charge of that portion which demands their special skill.

4. Engineers should be employed as one body as much as possible; consequently, when they have charge of several different kinds of work, the relative degree of urgency should be borne in mind, and work begun upon that work which should be finished first, followed by the other work in rotation. If, however, it is necessary to carry out several different types of work more or less simultaneously, the engineers will be divided.

When the situation specially requires it, there are occasions upon which a portion of the engineers may be temporarily held back as a reserve.

5. As soon as an action has once begun, until its final stages, the engineers must carry out successively every kind of work required, in accordance with the progress of the engagement. It is therefore essential that the officer commanding the engineers should watch the course of the action throughout, and be thoroughly conversant with the situation at any moment. When carrying out any work, however, he must always obtain the orders or sanction of the commander of the force.

6. An engagement is usually opened by the protective troops, or by those having some other special duty; the officer in command will now rapidly make the necessary dispositions, and check the advance of the enemy, while reconnoitring his condition and the configuration of the ground. The commander of the force, taking with him subordinate commanders as required, will then take up a position as near the enemy as the situation will permit, and observe the conditions on both sides, especially the configuration of the ground; he will give security of action to the troops of protection, etc., and, if necessary, form up the main body preparatory to deployment. At this time the engineers attached to the troops of protection will, under the orders of the officer commanding the latter, carry out such work as may be necessary for checking the advance of the enemy. On the completion of the work, or on occasions when there is no need of any work, however, they will usually return to the direct command of the commander of the force, and will be mainly employed in carrying out work to facilitate the deployment or forming up of the main body.

The officer commanding the engineers will carry out the required

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reconnaissance, based on the intentions of the commander of the force, and will furnish the latter with the necessary material for making his decision and arrangements.

7. The commander of the force decides the general plan of the engagement, and, based on this, issues his orders. The infantry then begin the movements for attack, or for occupying some indicated point, while the artillery take up a position. At this time the engineers are usually all under the direct command of the commander of the force, or, according to requirements, a portion of them are attached to the troops in the first line, and carry out any work necessary to facilitate the conduct of the attack, or the occupation of a position.

8. When the commander of the engineers receives an order from the superior commander, he learns from it the situation of the enemy and of our own troops, the superior commander's intention, and his own duties, etc.; he should then immediately carry out the required reconnaissances, employing, if necessary, the requisite officers.

A reconnaissance must be rapidly executed; if the right moment for making it is lost, it will have no value at all, even though an accurate result be obtained; undue haste, which may deteriorate into carelessness, must not be aimed at. The effect of any work depends solely on the quality of the reconnaissance.

9. The officer commanding the engineers, as a result of the reconnaissance, should determine rapidly and accurately the scheme and distribution of work.

The essential points as regards the scheme and distribution are as follows: a decision as to the class and extent of the work, and the order and means of carrying it out, bearing in mind the indispensable requirements of the moment, and the time available, etc., based upon the situation, and, particularly, the object of our troops; and a division of the *personnel*, tools, and stores, in accordance with the above.

10. When the plan and distribution of the work has been decided, the engineer commander should issue orders, based upon them, to each of his subordinate commanders; these orders must be short and clear, so that each subordinate commander understands the dispositions of the enemy and of our own troops, the intentions of the engineer commander, the duties of each portion of his command, and the allotment of tools and stores, etc.

In issuing orders, the engineer commander should assemble all his subordinate commanders, point out the actual ground, and give them a general order; it is often profitable, however, to issue separate orders, or, first issuing short orders (and so rapidly getting each party to the desired position), then to issue detailed orders. The

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summoning of a commander of a body of troops engaged in work, or in action, to a distant point, and giving him orders, must at all times be avoided.

11. When orders have been issued, the execution of the work, or preparations for it, will be immediately begun; at this time the engineer commander will rapidly report to the commander of the force the expected time of completion, and, if necessary, an outline of the scheme.

12. The engineer commander controls the work of each portion of his command, so that it is executed in accordance with actual requirements; it is of special importance that work should be completed at the right time, so as not to delay the general conduct of the engagement.

13. When work has actually begun, even in the event of meeting some unexpected hindrance, subordinate commanders of every rank should carry on resolutely with firm determination, without uselessly changing their plans, or hesitating over their execution. Even should there be a change in the situation, everyone should not wait aimlessly for orders, but should make arrangements suitable to the moment, and in accordance with his special duty; an immediate report should be sent in of what has been done.

14. When executing any work, care should usually be taken to conceal oneself from the enemy's view; if the situation requires it, however, work must be carried on bravely and smartly, and without concern, even when exposed to the enemy.

15. During the execution of any work, when there is no covering party, measures for self-protection must be taken; should an attack from the enemy be received while at work, the necessary strength must at once be detailed to oppose it, while the remainder carry on with the work.

16. During the execution of any work, the engineer commander should be in constant communication with the commander of the force, and should report the state of progress to him from time to time, notifying also the commanders of other troops concerned; also, if necessary, he should carry out any reconnaissance in connection with work to be executed next, and settle on his scheme. His subordinate commanders should also act on these lines, and must maintain certain communication with the engineer commander, while making preparations to be always able to comply with any subsequent requirements.

17. The position of the engineer commander should be selected mainly so that he can direct the whole of the work; in addition, the rapid delivery of orders and reports must also be considered. If the units under his command are working in places widely separated, he will take up his position at the point where the most important work

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is being carried out, and inspect the work of the other parties as may be necessary. If he changes his position, he must settle the means by which orders, reports, etc., shall reach his new position without delay.

18. For the transmission of orders, messages, and reports, the engineer commander will make arrangements for orderlies and telephones, settle on signals, frame codes, and devise various other expedients.

19. When no engineer work is being carried out, the engineer commander, in order to meet any demands for work arising unexpectedly, and bearing in mind the convenience of knowing thoroughly the changes in the military situation, should usually take post at the superior commander's position.

20. When an engagement is actually in progress, those engineers who are unemployed will usually form the reserve, with the infantry; a formation should be chosen so that they may be controlled as conveniently as possible, that suits the configuration of the ground, and that will render an advance easy; the reduction of casualties from the enemy's fire, however, must also be considered.

21. When engineers fight in co-operation with other troops, it is very important that connection should be preserved; the engineers, however, are strictly forbidden to think only of keeping connection, and to hesitate in executing their own special duties.

22. As the battle progresses, the infantry and artillery develop to the greatest possible extent the effect of their fire, and the infantry eventually deliver an assault; the engineers, therefore, should first clear a passage for these troops, and then charge with the infantry.

23. When victory is in sight, it is very important that the engineer commander should make preparations for the pursuit, without losing any opportunity.

24. Retreat easily degenerates into rout, and is liable to reach a stage when it is impossible to rally; the engineers, therefore, even when the situation is unfavourable, should exert themselves in every possible way, and, co-operating with the other branches, endeavour to retrieve the fortunes of the fight.

25. At night both the command and the movement of troops are difficult, and mistakes are easily liable to arise; for night work in the case of engineers, therefore, it is specially important that the scheme, and preparations, are thorough and accurate, and the distribution simple; further, orders in connection with night work should be issued as far as possible by day, and all preparations completed before sunset. There are occasions, also, when it is of advantage to point out beforehand the first steps to be taken after the completion of the work.

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SECTION 2.—THE ATTACK.

General Rules.

26. Generally speaking an attack is the sole way of gaining the victory; its essence consists of a courageous advance against the enemy, with firm determination and a single mind. Natural and artificial obstacles, however, often hinder this, and make its execution difficult; the work of the engineers in the attack, therefore, has for its principal object the removal of these obstacles, and the facilitating of the infantry's advance to the attack, and particularly the actual assault.

27. The secret for disposing troops for the attack is the employment of overwhelming force at the actual point of attack; the main force of the engineers is also usually made use of in this quarter, but when there is need of executing any important work in another direction, the majority of the engineers may be employed there.

28. An attack is advantageously made by enveloping the enemy, that is, by attacking him in front and flank simultaneously; it is usually carried out by the advance of several columns together, or by reinforcements from the troops in rear. In order for the troops debouching on the flank of the enemy to manœuvre as rapidly as possible, there are times when it is necessary for a large force of engineers to make arrangements for communication.

29. At the beginning of an action, when the advanced guard, and other protective troops with special duties, are taking steps to check the enemy's advance, the engineers should, if necessary, join in the work. There are times also when the engineers must rapidly arrange for a good lookout, so that the advanced guard commander and the superior commander may have a convenient spot for observing the situation.

30. As soon as the superior commander has decided on the dispositions for attack, and issued his orders, each unit deploys, either from where it is formed up, or from column of route; the engineers are responsible for clearing communications for them, and facilitating their movements. In order that the artillery may have a good position, it is specially important that the engineers should facilitate its occupation, by strenuous work should the configuration of the ground be bad; the reason for this is that the quality of the artillery positions has an intimate connection with the infantry's advance to the attack.

31. When every unit has completed its deployment, the infantry advance to the attack, and endeavour with one accord to approach the enemy. The engineers, therefore, if possible, should reconnoitre the ground in front beforehand, with the infantry, and when an

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obstacle is encountered, dash forward in front of the infantry line and prepare for its passage.

32. Even an inch of ground that has once been occupied must never be given up again to the enemy. For this reason works must be constructed if necessary, and the place strengthened. On these occasions the engineers should assist the infantry's work as required, or should work independently at some specially important point; the progress of the attack, however, must never be delayed on account of this work.

33. The distance that should be taken up by the troops in rear varies according to the situation, and, more especially, to the configuration of the ground. In open country, at the beginning of an action, this distance is considerable, and is subsequently gradually reduced. Care should be taken, however, not to suffer casualties in both echelons simultaneously on account of the danger zone of infantry fire, or of shrapnel; on this account the necessary distance is about 300 metres. But when the moment for decisive action approaches, the troops in rear must close up to the line of battle, regardless of casualties.

34. As soon as the moment for decisive action has arrived, a portion of the artillery usually advances to the most effective range, and the machine guns also endeavour to push forward to the front, the engineers, therefore, must prepare lines of advance, and positions in plenty of time.

35. If the enemy cannot be driven away merely by rifle fire, it is absolutely necessary to deliver an assault; consequently the engineers must first remove any obstacles and clear lines of advance, and then carry out the charge in company with the infantry. When a counter-attack from the enemy is received, they must fight hard to the utmost of their power, and try to bring about a successful charge.

36. When the engineers attached to the assaulting party use hand grenades, they should hurl them all together when the enemy is unprepared, and this moment must be utilized for delivering the assault. Any attempt to carry out a charge after a regular duel with hand grenades has once begun, will tend rather to impair the spirit of the advance and attack.

37. When a charge has been successful, the engineers should immediately take steps to facilitate the advance of the artillery, and, if necessary, to strengthen the ground seized. The engineers not employed on this work, however, will vigorously continue the attack with the infantry, up to some point where they can bring pursuing fire to bear upon the enemy; those units which do not join in the pursuing fire, will quickly arrange their ranks, and prepare for a subsequent pursuit.

Even if the enemy's position has been seized, care should be taken not to expose unnecessarily a large target to him, other-

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wise considerable casualties may be incurred in a very short time from some other part of the enemy's position, especially from his artillery.

38. When a charge is repulsed, the engineers, fighting bravely, must stand fast in the nearest possible place, and they must specially try, by means of keen and bold actions, to enlarge the lines of attack once more, or to construct rapidly strong supporting points to facilitate a subsequent charge, and do everything else possible to achieve success.

The Encounter Action.

39. In the case of an encounter action, in order to gain the advantage of the initiative, the superior commander will rapidly dispose his troops with firm decision, even if the situation is not yet clear ; for this reason, each subordinate commander must act upon his own discretion according to the changes in the situation, in such a way as to fulfil the wishes of the superior commander.

40. The advanced guard, in order to fulfil their mission, will bring on an action if necessary, and should the frontage be very wide, a strong supporting position will be occupied without delay. On this account, the engineers attached to the advanced guard must assist the infantry and artillery as necessary, carry out works to make occupation secure, and, in particular, clear the necessary roads for the advance of the artillery ; further, when the intention of the superior commander is known, they must prepare a position, and approaches, for the artillery of the main body. When there is any fear of the enemy completing his deployment first these measures are specially important.

41. In encounter actions, in order to complete deployment before the enemy, it is an advantage for each unit to deploy direct from column of route. The superior commander, although he should use every endeavour to join battle with his whole force under his control, will, on occasions when he wishes to confirm an advantage seized by the advanced guard, or to reinforce the latter without losing time, order each unit of the main body as they successively arrive, immediately to take part in the combat. On these occasions the engineers will be principally responsible for work to facilitate the deployment of each unit, more especially the artillery, and also the infantry's advance to the assault. The engineer commander, therefore, must endeavour to bring the engineers of the main body to their work in front, as rapidly as possible.

42. In an encounter action, each engineer subordinate commander will see that he is acting in conformity with the rapid course of the action by making special efforts to be prompt in his plans, dispositions, and actual execution of work. He must not lose valuable time by a desire to execute some perfect piece of work.

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The Attack against an Enemy who has Occupied a Defensive Position.

43. Against an enemy who occupies a defensive position, the attacker usually has plenty of time to reconnoitre the enemy's dispositions, and the configuration of the ground, and also to choose the time, direction, and method of attack; he must therefore determine on detailed plans, and make very full preparations beforehand.

The value of the enemy's position has a considerable influence on the plans of attack; in the case of a strong position, in particular, the result of the technical reconnaissance forms the foundation of these plans. The engineer commander, therefore, by elaborating schemes for every eventuality, based upon the superior commander's wishes, and by reconnoitring the configuration of the ground, the condition of the enemy's position, especially the construction of his *points d'appui*, the type and degree of strength of his obstacles, and the arrangements for flanking defence, etc., must strive to supply the superior commander with material for plans for a powerful attack. Even during the progress of the action, the engineer commander will continue to act on the above lines.

44. The superior commander, having issued his orders, first forms up his troops preparatory to deployment; at this time the advanced guard will avoid bringing on a conflict, but will be ready to oppose the enemy if he should assume the offensive. The reason for this is that a mobile defender may assume the offensive at the moment that the head of the attacker's troops appears. The engineers attached to the advanced guard, therefore, must take the necessary steps for the artillery to enter their position rapidly, and must also frequently carry out work to strengthen important points.

45. When the plans for the attack have been finally settled, each unit takes up its position preparatory to attacking, in accordance with the orders of the superior commander. The engineers, therefore, must prepare as rapidly as possible covered approaches for each unit, especially for the artillery; the reason for this is that it is essential for the artillery to open fire not only at the same time as the other units, but also unexpectedly.

As soon as each unit has reached its position preparatory to attack, the engineers will co-operate with the infantry as rapidly as possible, and make a detailed reconnaissance of the configuration of the ground; if necessary they will execute any work required, or make preparations to do so, and so wait for the orders as regards the advance, from the superior commander.

46. When the attack does not progress easily, or if an attack in force by daylight is not required, it is often profitable to approach the enemy under cover of night. On these occasions the engineers

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will previously carry out a reconnaissance of the ground in front, with the infantry and artillery, before sunset; in order to facilitate the night movement, they will clear the necessary lines of advance, or take steps to mark them, and make any other arrangements required.

47. When carrying out an attack against a very strong position, there are times when one is compelled to approach the enemy by constructing successive attack positions; this has the disadvantage, however, of being wasteful of time, and of allowing the enemy to still further strengthen his defence, so the attack positions must be constructed as near the enemy as possible.

48. It is not necessary for attack positions to be in one connected line, but the total length of such positions in any locality must be suitable to the strength of the troops in the first line; the intervening spaces, also, must be able to be defended by the fire of the adjoining attack positions, or by means of reinforcements from the troops in rear.

49. In order to make safe the communication between the attack positions, and from the ground in rear, communication trenches must be excavated as necessary; their direction and width will be determined by the enemy's dispositions, the configuration of the ground, and the kind of troops who will pass through them.

50. Although the construction of attack positions and communication trenches is mainly the duty of infantry, the engineers will direct or help them when necessary; any special arrangements, however, will be mainly carried out by the engineers. There are also times when they take charge of the tracing of the works and trenches.

51. When actually constructing an attack position, each working party will send out patrols in advance of the line where it is working, and if the enemy should make a sortie will themselves oppose it on the line of their work; in a dangerous quarter, however, protective troops must be specially posted.

52. Attack positions and communication trenches are usually constructed under cover of night; the troops begin work on them immediately on reaching their prearranged positions, and the work must be at least advanced to such a stage by dawn that the trenches may be enlarged during the day, and subsequently gradually strengthened as may be necessary.

53. When it is possible to construct the whole length, or a greater part of the attack positions, or communication trenches simultaneously, it has the advantage of making the progress of the attack uniform and rapid; but as the execution of the work becomes gradually more difficult in proportion as the enemy is approached, it is often better to work on these occasions with several small parties unknown to the enemy, and execute disconnected works, which are joined up later.

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54. In the construction of attack positions and communication trenches, care should be taken to work secretly, in order to avoid being discovered by the enemy; if discovered by the enemy, and coming under his fire, the work should not be stopped, but continued as long as possible, and efforts made to complete it rapidly.

55. When the attack has progressed so far that the remaining distance to be covered can be probably charged over in one rush, a final attack position will be constructed, and passages for the charge cleared, in order to prepare for the assault.

56. Until the infantry have occupied the final attack position, the artillery will advance their position under cover of night, according to circumstances. A portion will frequently push forward into the very front line, in order to bring the most effective fire upon the point of assault; there are occasions, therefore, when the engineers must execute a considerable amount of work, in order to provide the artillery with a covered position, and lines of advance.

57. When clearing paths for the assault, the engineer officers must make sure that there is no miscalculation, by determining beforehand the places and methods of passage, and by getting ready the tools and stores required.

58. In clearing passages for the assault, the engineers should carry out the work under cover of darkness, mist, etc., or under covering fire from our own troops, and complete the work before the assault; if the situation does not permit this, however, they will advance at the head of the assaulting party when the latter charge, and carry out the work by sheer force.

When paths for the assault have been cleared before the assault, the engineers will keep them under observation; they will also once more reconnoitre the state of the obstacles immediately before the charge, to make sure that the enemy has not repaired them, or placed new ones in position.

59. There are often very formidable arrangements for checking an assault, in the case of the *points d'appui* of a very strong position; the attack of such will follow the lines of an attack on permanent fortifications, very great reliance being placed upon the engineers' special technical qualities.

Section 3.—The Defence.

60. Defence is liable to degenerate into passive resistance, and result in our losing freedom of action, consequently it must be turned into a decisive offensive as soon as an opportunity presents itself.

The conduct of a defence when it is intended to win a decisive victory must invariably be carried out in conjunction with offensive movements; when the object is merely to contain the enemy,

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however, all that is necessary is that the position be held on to with all one's strength. The selection and preparation of a position is primarily determined according to which of these two objects is in view.

61. The superior commander will determine what kind of defence shall be carried out, in accordance with the mission allotted to him, after considering the condition of the enemy and of our own troops, and the configuration of the ground.

The engineer commander, in accordance with the intentions of the superior commander, will make a rapid reconnaissance of the configuration of the ground, and submit the necessary *data* as regards the occupation of the position, and, more especially, its preparation for defence.

62. In the defence, the work which the engineers take charge of is very considerable; consequently it is specially important for the engineer commander to arrange with the very greatest care for the distribution of his men, and the order in which they shall begin work, in a suitable manner.

63. It is especially important for the troops who occupy a position to be able to develop fully the effect of their fire, and the position must also always have a belt of ground where the offensive can be assumed.

The position must be suitable to the strength of the force. It is advantageous to make use of high ground, villages, woods, etc., in so far as they do not hinder the adoption of the offensive; but one must not be dazzled by the existence of local ground features which might possibly exert an unfavourable effect upon the position as a whole.

The most favourable position is one where the ground in front is open, and there is a distant field of fire, where there is free communication internally and to the rear, where there is concealment from the enemy's view, and where the flanks can be supported by strong *points d'appui.*

It is seldom that each portion of a position possesses all the desired attributes; any defects, therefore, must be supplemented by a suitable distribution of troops, and by the construction of appropriate works.

64. When about to take up a position, a party is usually pushed to the front with the object of covering our occupation of the position. On this account, when the enemy is near, there are times when a few infantry detachments are pushed forward to offer a temporary resistance; in most cases, however, this mission is allotted to the cavalry, who merely reconnoitre the enemy's dispositions, and, if possible, delay his advance.

65. The infantry fighting line is usually prepared in front of the artillery position, and must be chosen so that there is good fire effect

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from our infantry and artillery against the enemy's infantry, and at the same time that our artillery may be covered; although the distance in front varies according to the configuration of the ground, on level ground about 500 metres is suitable. The positions for the machine guns are on the line of the infantry position, and may be prepared either actually in the fire trenches, or in detached spots; sites must be selected so that there is no danger from the enemy's long-range shells. It is also frequently necessary to prepare reserve positions for the artillery and machine guns.

The artillery and machine guns must be able to develop their fire effect to the fullest extent against the expected direction of the enemy's attack, and at the moment of our taking the offensive must be able to bring very effective fire on to the zone over which our troops will advance.

66. The superior commander, according to the object of the defence, and bearing in mind the configuration of the ground, and convenience of command, divides the position into a certain number of sections, and allots to each a suitable complete unit. Work on the position should usually be executed by the troops detailed as garrison for each section; the engineers not only direct this work, and assist generally, but are responsible for the preparation of important portions of the position, especially *points d'appui*, communications, etc.

In order not to provide the enemy with an area of safety, the superior commander will allot the ground in front to the section of the defence, and see that each section can flank the dead ground in front of the neighbouring sections.

67. A series of lines must not be constructed with the object of defending a position step by step; only a single position must be prepared, and that one made extremely strong.

68. In the case of a position where the object in view is a decisive action, strong works will be constructed on those important points which support the position; work in other places will usually be confined to the smallest limits. In the case of a position where the object in view is merely defence, however, all parts must be strengthened, and especially powerful works constructed in addition on important points which support the position.

In every case it is essential that the provision of internal roads for communication, and arrangements for signalling and lookouts, be perfected, that the field of fire is widely cleared, and that distances are measured; and particularly when a decisive action is in view, full provision for communication must be made, so as to facilitate the advance to the attack of the general reserve.

69. Defence works should not be constructed by forming a connected line of fire trenches, but by dividing the works into several groups; in the case of a large position it is usually a good

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plan to allot a battalion to each group. The intervals between these groups of works, and the ground in front, must be under the effective fire of neighbouring groups; if the configuration of the ground, or some other condition requires it, any work necessary may be carried out in the intervals.

In the case of a group of works having for their object the stubborn defence of some particular locality, strong defence works should be constructed against every quarter; with the object of checking surprise attack, in particular, obstacles should be prepared round the perimeter. When the locality is cramped, however, and it is not possible to arrange for a group of works, a closed redoubt is constructed instead.

70. The time required to carry out any work should be estimated, and the work arranged accordingly; in the event of there being any spare time over, the work will be gradually strengthened.

71. It is important that the position, and particularly the defence works on it, should be concealed from the enemy as long as possible; on this account patrols are sent out from each section to the front, or observation parties posted, so as to check the enemy's scouts; it is also of advantage, however, to construct covered, and disguised, works.

In order to mislead the enemy as to our strength and dispositions, false works are sometimes constructed.

72. When the construction and arrangement of works is suitable, the fighting strength of a force is enormously increased for the numbers required for the defence are economized, and the general reserve destined for the assumption of the offensive, increased: consequently the effect in making the foundation of victory sure is very considerable.

73. It is usually very important for the defence to know the enemy's intentions; if the works which he is carrying out are carefully observed, there are times when his plans may be conjectured.

74. The course of a defensive action depends on the advance of the enemy; the garrison of the position, by developing the effect of their fire more and more fully as the enemy approaches, endeavour to destroy him. During this time, the engineers make the defence works still stronger, if necessary construct new works or repair those destroyed by the enemy, etc., and constantly endeavour to perfect the position.

75. When the enemy's attack is checked by the fire of the defenders, or when the enemy is observed to commit some fault, the superior commander will at once make use of his general reserve, and assume the offensive, while, if necessary, all or part of the garrison in the position will be simultaneously moved forward to the attack. At this time those of the defender left in the position, by developing the effect of their fire to the fullest extent, will prevent

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the enemy in their front from having any leisure to consider what is going on elsewhere.

76. During the course of an action, if there should eventually be no opportunity to be seized, and the enemy have pressed forward to a very short distance, the garrison should bring all their fire to bear, cause the enemy to waver, and then dash out on him with their whole line ; in the event of the enemy's troops bursting into our position, a desperate fight must be maintained to the last.

77. Defence at night is doubly difficult ; the defenders, therefore, should exhaust every expedient to guard against the enemy's approach. With this object in view the engineers will light up the foreground, and keep the obstacles under observation ; they are also responsible for discovering any works that the enemy are constructing.

78. When the position is strong and the defence stubborn, the enemy is eventually obliged to approach us by constructing successive attack positions.

When the enemy is about to carry out work on these, the defenders must immediately search them out, and endeavour to hinder the work and delay the progress of the attack by means of sorties with small parties composed of infantry and engineers. For this reason it is essential that engineer officers should continuously reconnoitre the enemy's works, and discern his intentions quickly.

During the progress of an engagement a particularly important duty of the engineers, in conjunction with the infantry, is the preservation of our obstacles ; consequently, when the enemy approaches to close quarters, and plans the destruction of the obstacles, he must be hindered to the utmost of our power. If necessary the enemy's onset must be checked by repairing the obstacles, or constructing them anew.

79. The preparations for withstanding a charge, and the defence of a strong *point d'appui*, follow the principles of the defence of a permanent work ; on those occasions, also, the engineers assume very important duties.

Section 4.—Pursuit and Retreat.

80. When victory is won in an engagement, it is very essential that a fierce and resolute pursuit be immediately undertaken, so that the effect of the defeat may be driven home by the destruction of the enemy's forces. For this reason, every unit which has dashed into the enemy's position should open a severe pursuing fire, and, when the enemy is about to escape from the zone of our effective fire, at once rapidly pursue him. The superior commander will rapidly organize a pursuing force from those units which are comparatively concentrated and conveniently placed for an advance,

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and make this force responsible for the pursuit; those units who are already in pursuit will be re-formed, and preparations made for a fresh advance. On these occasions the engineers attached to the pursuing force must move near its head, clear away obstacles prepared by the enemy, and facilitate the movements of the pursuing force, more particularly of the artillery.

81. During the pursuit the removal of obstacles must be extremely prompt; if this work is delayed the enemy will succeed in escaping from our rapid pursuit. The commander of the engineers attached to the pursuing force, therefore, should quickly come to a decision as regards the configuration of the ground and carefully consider the likely points on the enemy's line of retreat where obstacles may be constructed, and also the method of construction; if necessary he should prepare the requisite tools and stores beforehand; he should also send out officers far to the front to reconnoitre the obstacles prepared by the enemy, arrange for methods of removing them, and to ascertain whether there is a good route for making a detour round them.

82. After an action, the exhaustion even of the victors is considerable; but both the strength and spirit of the vanquished are very low, and their exhaustion has almost reached the extreme limit. In order that the pursuers may continue the pursuit resolutely, therefore, every officer must not hesitate to make demands upon his men for the utmost exertions possible.

83. The essential point in the conduct of a retreating action is to rapidly get free from the enemy; for this reason the superior commander will carry out the retreat by making arrangements to move in as many columns as possible, after indicating the objective of the march, detailing the covering troops, and pointing out the covering position. At this time the engineers will prepare the covering position and construct obstacles to delay the enemy's pursuit; if necessary they will also be detailed to repair the roads on which the retreat takes place, and so facilitate the movements of the force.

84. When the superior commander has decided to retreat, the engineer commander, acting in conformity with his intentions, will send out as quickly as possible several officers to reconnoitre various parallel roads leading towards the destination of the retreat; according to requirements a sufficient number of engineers will be sent forward to repair the roads.

85. As soon as the superior commander has made his dispositions for retreat, a certain number of engineers will usually be detailed to the covering force, and the others divided among the columns as necessary; at this time, if the engineer commander has already received the superior commander's wishes, he may carry out the reconnaissance in connection with the preparation of the covering position.

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86. A covering position is selected in accordance with the general situation, so that the retreating force may be able to concentrate under its shelter, and also be able to make a sortie. The artillery position requires to be chosen, as much as possible, to the flank of the line of retreat, or on high ground in the vicinity. The engineers will take especial care to clear and repair the roads so that the artillery can occupy their position easily, and evacuate it rapidly; if necessary they will carry out any work to render the close approach of the enemy difficult.

87. It is very advantageous if the covering party can become the rear guard at once; if the situation does not allow this, however, a new rear guard is detailed.

The engineers attached to the rear guard are responsible for delaying the enemy's advance by either destroying or barricading the roads and bridges, etc. If the place and method selected are suitable, a considerable effect is gained; and if the enemy is prevented from repairing the damage, by means of a few cavalry and infantry, the effect is still greater. The engineers, therefore, even if the enemy's pursuit is extremely hot, must not consider their own casualties at all, but must carry out their work coolly and accurately. Further, when the rear guard halts with the intention of checking the enemy, it is often necessary for the engineers to construct some works.

88. When it is anticipated that a retreating force will occupy a new position, the engineer commander, in accordance with the intentions of the superior commander, should make preparations to join up the various portions of his command which are distributed among the several columns, during the retreat, so that he can have them under his hand immediately after arriving at the new position.

On these occasions the majority of the engineers are often sent on ahead in order to prepare the position.

Section 5.—The Delaying Action.

89. The object of a delaying action is to avoid a decisive engagement, and to gain time.

When troops detailed to cover any operations have to join battle, they usually fight a delaying action. There are also occasions when the troops in the enemy's front adopt the same course, when it is intended that they should wait for an opportune debouchment of troops detailed to surround, or make a turning movement against, the enemy, etc.

The works executed in a delaying action are, generally speaking, the same as in a defensive action; it is important, however, that they are carried out bearing in mind whether the subsequent operations will be defensive, or whether the offensive will be assumed.

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90. In delaying actions, in every case the units in the front line will usually be deployed on a front wide in proportion to their strength; it is often specially important, therefore, for the engineers to execute in these engagements a considerable amount of dummy, and covered, works.

SECTION 6.—RIVER FIGHTING.

91. Rivers and streams intercept both attacker and defender, and render their movements and scouting difficult. When properly utilizing their special characteristics, therefore, the attacker can surprise the enemy, or, deceiving him, overcome his opposition, cross the river and deliver an attack; while the defender, according to the object in view, can assume the offensive at the moment that the enemy is half across the river, or else can confine himself to opposing the passage. The engineers, therefore, especially in the attack, must play a very important *rôle* in preparations for the passage of a river.

92. In the attack, the engineer commander, in accordance with the intentions of the superior commander, will reconnoitre positions for bridging, for the crossing of the covering party, and for the forming up of the bridging train; if necessary he will find out whether there is any material that can be improvized, available. For this purpose he will employ a certain number of engineer officers; it is advisable for the commander of the bridging train, also, to reconnoitre the ground where the train is to form up.

The site for the bridge will usually be a place opposite an important tactical point, and conveniently situated for an advance; it should possess a suitable covering position, and be hidden from the enemy's view and fire, the ground on both banks should give free communication, and have suitable positions for the troops to assemble, and for the bridging train to form up. Further, the state of the river must suit the bridging material to be employed, the work to be executed on both banks must be simple, there must be a suitable place for laying out stores, and the banks must be convenient for launching boats.

The place where the covering party cross must be chosen in a locality as near as possible to the site of the bridge without interfering with the bridging work; it must also have several departure and arrival points, convenient for embarking and disembarking.

The forming-up ground for the bridging train should be selected near the site of the bridge, and be of the required width; it should be a spot where the surface of the ground is as level and as hard as possible, so as to facilitate the movements of the vehicles, and the unloading and arranging of stores.

In collecting improvized materials, they should be taken as much

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as possible from near the bridge site, and particularly from points up-stream, for convenience in transportation.

93. The passage of a river in presence of the enemy is extremely difficult; it is, therefore, necessary to surprise him, or to deceive him by a demonstration and then cross rapidly. It follows, therefore, that the reconnaissance, and every movement in connection with the passage, must be concealed from him. Consequently the preparations for the passage should be carried out at some spot out of the enemy's sight and hearing, and should be completed as much as possible before beginning work on the bridge; bridging must often be carried out at night and completed before dawn.

94. When crossing a river in presence of the enemy, it is almost impossible to avoid discovery up to the very last moment, and it often happens that the rest of the passage has to be carried out by sheer force after half of it has been accomplished. The attacker, therefore, in order to cope with this eventuality from the first, will place his infantry and artillery under cover, and take up a position with them beforehand on the near bank, in addition to taking any other steps he can think of. The engineers also will complete all necessary preparations, and calmly continue their work even if hindered by the enemy.

95. In bridging work it is usual to send a party of infantry, supplemented if necessary by some cavalry and artillery, to occupy any important ground on the farther bank, so as to cover the operations; with this in view the engineers should prepare beforehand as many boat rafts as possible, and be responsible for ferrying over the covering party.

Even during bridging operations, the engineers must make use of as much material as possible in the way of boats and rafts, provided the actual work on the bridge itself is not delayed, and endeavour to pass the infantry of the force to the further bank, after the crossing of the covering party has been completed.

96. The moment for the passage of the covering party is determined after taking into consideration the general situation, and, in particular, the configuration of the ground; it is essential that it should not be carried out prematurely, or our intentions will become known to the enemy.

In transporting the covering party across, as many units as possible must be landed simultaneously on the enemy's bank at the first journey; care must be taken not to break up these units.

97. The spot where the demonstration is made must be chosen so that the enemy may be deceived into thinking it is the point for the real crossing; and various bridging operations must be carried out there so that the enemy cannot distinguish them from those carried out at the real crossing point.

98. In the case of bridging operations in the presence of the enemy

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column stores are principally used ; in order to meet any subsequent demand for these stores, however, it is very important that they should be replaced by improvized stores as quickly as possible.

The taking down of any bridge will usually depend upon the order of the superior commander.

99. The secret of defending a river is the assumption of the offensive when the enemy is half across. For this reason observation parties should be posted at all anticipated crossing places, while the main body should be concentrated and placed at some spot whence it can rapidly confront the enemy from whatever direction he should come. It is very important not to be deceived by a demonstration on the part of the enemy ; cavalry, therefore, will be sent forward to the farther bank to search out the enemy's dispositions. At those places, however, where it is specially important to ascertain whether the crossing is real or false, engineer officers should be sent out to reconnoitre the enemy's intentions.

100. In the defence, the engineers should first collect any material for crossing that exists in the neighbourhood, and moor it on the near bank ; they should either destroy, or prepare for demolition, any bridges that might be used by the enemy ; they should reconnoitre fords, and, if necessary, carry out any work required to make the enemy's crossing by means of them difficult. Finally, they should complete any arrangements necessary for the onset of the main body, and for communication and observation, at the moment when the offensive is assumed.

101. In the case of a defence whose object is to delay the enemy, the troops will be posted directly along the river ; on these occasions the engineers will be specially responsible for the preparation of positions, and for obstructing all the enemy's intended plans for the passage of the river.

SECTION 7.—HILL, WOOD, AND VILLAGE FIGHTING.

102. In all mountainous regions the ground for deployment is narrow, intercommunication inconvenient, and movements difficult ; it consequently often happens that all subordinate commanders are required to act on their own initiative.

In hill fighting it is often necessary for a portion of the engineers to be divided amongst the various units.

103. In mountainous country, both in attack and defence, efforts are made to occupy a position which commands the enemy, where artillery, and particularly mountain artillery and machine guns, can be used to sweep roads, valleys, and slopes with their fire, and where it is easy to observe the enemy's movements. The engineers, therefore, with this end in view, are responsible for perfecting all arrangements for intercommunication.

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104. In mountain fighting it is necessary for the attacker to advance, making use of roads, valleys, and crest-lines leading in the enemy's direction, so as to cut off his line of retreat by surrounding him, or by threatening his rear with a distant turning movement. In order to attack, every unit makes use of dead ground and endeavours to seize a *point d'appui* or important saddle of the enemy's position; in the attack, therefore, the engineers must chiefly exert themselves in clearing the roads. After the attack is successful, and when a portion of the artillery, or machine guns, are about to join in with pursuing fire, it is especially necessary that the required arrangements should be carried out with rapidity.

105. In the defence of mountainous country, all roads leading in the direction of the enemy must be strongly guarded. When the communications are good the number of troops allotted to the various sections of the defence should be reduced, and the main body turned into the general reserve and stationed at some spot whence they can easily debouch; when communications are bad it is better to distribute the general reserve in several places. The troops in the first line must occupy important cols, and must be disposed so that they can command with their fire the valleys and slopes from the summit; in particular, they must be able to flank dead ground. The engineers, therefore, will take especial care to arrange for the flanking of dead ground; they will also make special provision for the cover of positions on the tops or sides of the hills from the concentrated fire of the enemy; and they will clear the necessary passages for the advance of the general reserve.

106. When a wood or village exists on a battlefield, they often become the focus of the fight; the defenders may occupy them and form *points d'appui*, while the attackers may utilize them as points of support for further operations. In the case of these topographical features, however, as movements and vision are restricted and control difficult, the engineers must carry out considerable intercommunication work.

107. It often happens that an enemy who is relying on a wood, and especially an enemy relying on a village, offers a stubborn resistance. In the attack of such, therefore, the engineers should destroy any obstacles, walls, etc., clear a path for the assault, hurl hand grenades if necessary, and, in conjunction with the infantry, drive out the enemy. When the enemy retreats, an immediate advance must be made on his heels, the obstacles on the route cleared away, and efforts made to push forward through the further edge of the wood or village; at this time, if the enemy is still holding on to any house inside the village, the engineers will destroy the walls and drive him out. The necessary signposts must also be provided without delay for the benefit of the troops in rear.

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108. When occupying a wood, the edge of a wood which can be easily distinguished by the enemy should be avoided, and a firing line selected in rear of the edge, at such a distance that the tree trunks do not obstruct our fire; in open, straggling woods, the above principle is especially applicable. In the case of very dense woods, there are times when it is advantageous to prepare the firing line in advance of the wood, and only use the wood itself to conceal the troops in rear. The engineers are responsible for clearing paths, erecting signposts, blocking up unnecessary roads, and preparing obstacles along the edge of the wood, etc.

109. When the construction of the houses and walls of a village is strong, the perimeter may be made the main line of battle; when the houses are made of wood, however, they are very liable to catch fire from the enemy's shells, and consequently should only be used for concealing the troops in rear, while the firing line had better be established in front. When the perimeter is made the fighting line, the area each unit is to defend must be settled in accordance with the condition of the houses and walls; even if the enemy should break in at one place, arrangements must be made that the other areas are not affected. It is essential to select a strong building in a suitable position, even when in the interior of the village, and to occupy it in order to facilitate any subsequent attack made by us to recover the place.

The engineers will prepare the walls and houses for fire, and arrange for necessary internal communications; when the troops are divided up among different houses, or the reserve located in the village, this is particularly important. It is also essential that unnecessary roads are blocked up.

110. In the defence of a village, when there is a hand-to-hand fight with the enemy round the enclosure wall, the engineers throw hand grenades, and, co-operating with the infantry, drive the enemy back.

SECTION 8.—THE ATTACK AND DEFENCE OF PERMANENT WORKS.

General Rules.

111. In the case of a permanent work, the arrangements for protection against assault are generally very complete; consequently the attacker approaches the enemy by means of saps and mines, on the surface of the ground and beneath it, and destroys these arrangements before delivering a charge. The defender also opposes the approach of the enemy by the same methods, and endeavours to preserve the arrangements that have been made for protection against assault.

112. Sapping, mining, and work in connection with the assault, both in the attack and the defence of permanent works, mainly

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depend upon the special skill of the engineers; and all of these usually have to be continued during many days under the most severe and arduous conditions.

The Attack.

113. In the attack of a permanent work, successive attack positions, based on a detailed plan, are usually made for the advance: the final advance is then carried out by means of sapping and mining, both on the surface of the ground and beneath it, until the crest of the glacis is reached; here an assault position is prepared as a *point d'appui*, the arrangements for checking the assault destroyed, and a charge delivered. When the arrangements for checking the assault are not very complete, however, or when the resistance of the defenders is not very stubborn, while the effect of our artillery fire is very great, every effort should be made to construct an assault position at such a distance in front of the fort that the charge can be delivered at one stroke, so as to carry the place at once with a single determined onset.

114. As the attack works gradually advance, and approach very close to the enemy's fort, the work is exposed even at night and becomes extremely difficult to carry out; consequently the final approaches, and attack positions, have to be constructed by means of sapping. The engineer commander, therefore, in accordance with the intentions of the superior commander, and bearing in mind the enemy's dispositions and the configuration of the ground, will determine the objective, and starting places, of the saps, and also the number of approaches; based on these decisions, the officer in charge of the construction of the saps will settle the direction of the approaches, their number, and the places for beginning them.

115. In excavating the sap, endeavours will be made to reach the destination as rapidly as possible; for this reason the enemy's dispositions will be continually reconnoitred, and the direction and number of the saps altered, so as to suit the occasion. Further, whenever there is an opportunity of carrying on the work while exposed, it must be pushed forward with the utmost ardour; at night, and when there is a thick mist, etc., the enemy should be surprised, and by rushing forward, as much cover as possible rapidly thrown up; by joining this up, and forming approaches and attack positions, every effort must be made to expedite the progress of the attack.

116. When it is known or conjectured that the enemy is mining, or if the attack saps are actually destroyed by their mines, and their progress has to be stopped, an attack position will be formed round the area of the explosion, and the subterranean enemy subsequently driven away by means of mining; our advance will then be resumed both on the ground, and beneath it.

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117. When about to drive mines, the engineer commander will judge the position, direction, and number, etc., of the defenders' mines, and make those ones which he wishes to destroy his objective; one system of mines will be settled for each objective, and the engineer commander will determine the position of the trench from which mining is to be started, and also the number of mines that are to be driven.

118. The trenches from which mining starts are usually in front of the attack position, and are arranged so that each system of mines should surround its objective as much as possible; their position is fixed so that they may be covered by the fire of the position in rear, and that they may not be damaged by the explosion of the defenders' mines. There are occasions, however, when mining starts from the attack position itself.

119. The officer in charge of a system of mines should see that the advance of the heads of the mines is uniform, so that the flanks of our mines may not be exposed to the defenders' mines; consequently, if even the slightest phenomenon should appear either underground or on the surface, it must not be disregarded, but continually watched, and the enemy's dispositions observed; it is also essential that all our movements should be concealed, and no material for observation given to the enemy. It is also of advantage to make use of every expedient to deceive the enemy, and mislead his judgment.

120. The officer in charge of a system of mines should advance by means of saps if an opportunity occurs, and endeavour to break into the middle of the enemy's mines by sinking a shaft.

121. As each mine advances, and the time arrives for blowing up the enemy's mines, a charge chamber should be immediately prepared at the head of each mine, these exploded simultaneously, and the craters occupied.

Sunset is usually a suitable time to select for the explosion, so that the craters may be occupied under cover of night; while waiting for this moment, however, one may be forestalled by the enemy, and suffer very great damage; rather, therefore, must one be too soon, than too late.

The party detailed for the occupation of the craters will complete all its preparations before the explosion, and take post at the nearest point where they will not be injured by it; after the explosion they will immediately advance towards the crater, the infantry establishing themselves on the lip and preventing the enemy making a sortie, while the engineers prepare the place for fire, and excavate the rearward communications.

122. Having occupied the craters, these are connected up, and an attack position formed, while mines are driven from the bottom of the craters.

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123. After the explosion, if the enemy's mines can be discovered and an entry effected into them, it is a great advantage; if an entry is once made, the utmost exertions must be put forth in order to brush aside the enemy's opposition, and occupy as much of his mines as possible.

124. The craters formed by the enemy's explosions must also be occupied without losing any time.

125. When the attack both on the surface and underground has progressed, and reached a point in front of the crest of the glacis, craters are formed, joined up, and attack positions formed by enlarging them; these positions must surround the front and flanks of the fort, so that the assaulting columns can advance from several directions.

126. When the assault positions have been constructed, mines will be pushed on again, the counterscarp wall and the arrangements for flanking defence destroyed, and a passage cleared across the ditch. Efforts will now be made to drive out rapidly the enemy in occupation of the remaining counterscarp mines and flanking casemates in the vicinity.

127. If the situation permits, an advance will be made by rushes above ground, and the ground in the neighbourhood of the glacis crest occupied; cover will be thrown up here, and shafts sunk and exploded.

128. When the counterscarp wall has been overthrown, and the arrangements for flanking defence destroyed, the obstacles in the ditch, and the escarp wall will be destroyed. If one cannot anticipate being able to carry out a single determined charge at one stroke, on account of the garrison of the fort still resisting with the utmost stubbornness, and the neighbouring forts pouring in a deadly fire, one is compelled to drive mines once more, this time beneath the parapet, with the object of overthrowing it. If possible the escarp slope and exterior slope should also be successively occupied by means of sapping, and the advance continued.

129. When the routes for the assault have been completed, the assault is delivered. In order to utilize the preparatory fire of our artillery, the assault is usually carried out by day; it is of advantage to deliver it just before sunset, so that the work in connection with the occupation of the place may be carried out under cover of night.

130. When the assaulting party occupies the assault position, their movements must be circumspect, and care taken that they are not discovered by the enemy; when it is impossible to avoid loss from the enemy's fire, it will be necessary to occupy the position only a short time before the assault.

131. When the moment for assault arrives, the infantry in the foremost positions will subdue with their fire the enemy established on the parapet. The assaulting party will form several columns

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according to the number of routes for the assault and, directing themselves against the front, flanks, and gorge of the fort, charge simultaneously. At this time the engineers will advance in front of each column, completely destroy the enemy's hastily-constructed obstacles, and facilitate the rush of the column ; a party of engineers will also follow immediately in rear of the assaulting party, in order to carry out work in connection with the occupation of the position, and clear rearward communications, after the assault has succeeded.

132. At the time of the assault, when about to cross over the ditch by means of the assaulting tools and materials, these must be thoroughly prepared according to the state of the demolitions ; when the infantry are to make use of them, it is essential that they should thoroughly master the methods of using them, under the guidance of the engineers, before the assault.

133. After the assault has proved successful, and even when the assaulting party have already occupied the parapet, a stubborn enemy will still continue his resistance from the interior of the fort, or from the vicinity of the gorge ; consequently the engineers, in conjunction with the infantry, will carry on a vigorous fight with rifles and hand grenades, and expel the enemy from the fort. The rest of the engineers will repair the parapet, and prepare it for holding.

134. After a successful attack, when the enemy has been completely driven out of the fort, the engineers, in order to make its occupation secure, will at once repair the fort, especially the gorge. If necessary they will rapidly construct obstacles, or repair the ones already existing ; search for any land mines prepared by the enemy, and cut the train ; and rapidly open up the rearward communications.

The Defence.

135. In the defence of a permanent work, the work which the enemy is carrying out must be reconnoitred, his intentions judged, and his preparations for approach and subsequent assault checked to the utmost of one's power.

136. When the enemy has begun his attack works, the defenders should frequently carry out small sorties, and hinder his operations ; usually the most advantageous moment to seize is when the enemy is about to begin work. When carrying out a sortie, care must be taken that the enemy does not pursue, and force an entry into our position.

137. When the enemy is gradually approaching, and intends advancing by means of saps, the engineers will usually check him by sapping forward to some place where they can bring flanking and oblique fire to bear upon him, and preparing a position there ; they will also, in co-operation with the infantry, dash out against the head of his saps, drive the enemy away by means of explosives and hand grenades, and endeavour to hinder his work as much as possible.

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138. The enemy will often advance with a single rush, under cover of night, fog, or a fierce artillery bombardment, and try to throw up cover ; the engineers must therefore continually be on the watch against this, and lose no opportunity of checking him.

139. When the defenders know that their fort lies in the direction of the enemy's attack, they must immediately supplement the mines that are already constructed ; the officers in charge of each system of mines, therefore, must at once start work, either based on already-settled plans, or, if necessary, after settling on a new scheme.

The mines of the defence must be pushed forward as far as ventilation will allow, so as to compel the enemy to start mining from a distance ; the depth of the mines should be fixed so as to allow of the enemy's mines being blown up from below.

140. In order to deceive the enemy, and engender in him a feeling of uncertainty and fear, it is of advantage to prepare beforehand detached powder chambers in an area where no mines exist, particularly towards the front of our mines.

141. When the enemy's saps have advanced, and reached the sphere of explosion of our mines, the latter must be exploded, and the enemy compelled to continue his advance by means of mining.

142. When the enemy begins mining, not only should his advance be checked by means of our mines, but every effort should also be made above ground to hinder the progress of his work ; the engineers, therefore, must endeavour to destroy the entrance of the mine, either by a stealthy advance, or by making a sortie with the infantry.

143. As the enemy's mines advance, and reach the neighbourhood of our mines, bore-holes should be made or branch galleries driven in a suitable direction for blowing up the enemy's mines, as far as it is possible, from a flank ; the explosion should not be too soon, but should take place as soon as the enemy's mines can be destroyed by it.

144. When a crater has been formed by one of the enemy's explosions, the engineers will dash forward resolutely with the infantry, hurl explosives and hand grenades, and use every effort to prevent the enemy occupying the crater ; they will also endeavour to blow up the bottom of the crater from below.

145. The enemy sometimes advances by rushes without mining, until he reaches the vicinity of the crest of the glacis, which he makes a starting point for driving his mines ; the defenders, therefore, must closely observe the enemy's movements, and use every effort to check his operations.

146. Should the enemy force his way into our mines after an explosion, every effort must be made to drive him out ; if the situation does not allow this, barricades will be constructed, and efforts made to dispute his advance step by step. If it should

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gradually become impossible to hold the mine, it must be completely destroyed by a small explosion, and its use denied to the enemy.

147. When the enemy has gradually advanced, occupying as he comes ground both on the surface, and below the surface, and is about to construct a position in the vicinity of the crest of the glacis, the engineers will hinder him by hurling hand grenades, or else blow up his works by means of subterranean boring.

148. Even when the flank defences and counterscarp wall have been already blown up, the defenders must still stand fast in the nearest casemates, stubbornly check the enemy's entry, repair the flanking defences as much as they can, or else rapidly construct new arrangements for flank defence either in the ditch or outside the fort. They should also clear away, if possible, the earth heaped up in the bottom of the ditch on account of the demolition of the counterscarp wall.

149. When the flanking defences, and outer ditch have fallen completely into the enemy's hands, and he has begun to drive fresh mines in the escarp, the engineers will hinder him both on the surface of the ground and beneath it ; they will also prepare new defence works inside the fort, and near the gorge, convenient for successive lines of defence.

150. When the parapet of the fort has been already destroyed, and the enemy, climbing up the parapet, charge in, the engineers will co-operate with the infantry and drive him back by means of hand grenades and the bayonet ; even if a portion of the parapet be eventually occupied by the enemy, a counter-attack must be delivered so as to surround the enemy, and strenuous endeavours made to drive him out.

151. When the enemy's charge has been repulsed, the engineers and infantry will securely occupy the parapet, repair it if necessary, and prepare for the enemy's return to the charge.

152. If the counter-attack is unsuccessful, and the fort is about to fall completely into the enemy's hands, he will be hindered in the works he is carrying out with a view to occupying the place, the previously-laid land mines will be exploded, and the enemy destroyed.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF SEBASTOPOL (*continued*).

The Way in which France and England administered to Their Armies.

In this work—only relating to siege work, and not being intended to include any description of the battles fought between the Russians and the Allies—no attempt has been made to describe the Battle of Balaklava fought on the 25th October, with its famous Charge of the Light Brigade, or of the heroic Battle of Inkerman fought on the 5th November.

We may now proceed to a short description of the way in which France and England ministered to their armies in the East.

To say nothing of our English stepping-stone, Malta, the Allied Armies were at first established on the territories of an ally, the shores of the Dardanelles and the Bosphorus, without confronting an enemy. Next, having been moved to Bulgaria they prepared to undertake regular operations in the field by striving to collect with all speed the requisite means of land transport.*

Next, transported by sea to the Crimea, and there landing without opposition, they seemed to have dominion of a country abounding in food for man and beast, and means of land carriage. Then, by their victory on the Alma, they converted their dominion of the country into unresisted possession, and for a moment it seemed that the task of supplying the armies had been happily lightened. But this only lasted for five days; for by their flank march, commenced on the 25th, the Allies abandoned their conquest of almost all the Crimea, and by descending the Mackenzie Heights, made the step they were taking irrevocable.

Next, intent on the siege, they suffered themselves to be compassed about, and imprisoned upon a small area of barren ground; and then it became evident that, at least for some time, the life of the troops must depend altogether upon what might be brought to them by sea.

* When the orders came out which suddenly shifted the theatre of war from Bulgaria to the Crimea, Mr. Filder had already collected 5,000 beasts of burden.

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But another and even more trying change yet awaited them; for in November, when already bleak winds and chill rains were sweeping over the Chersonese, it was determined that where the armies were, there they must be prepared to lie for months, and that the French Intendance and the English Commissariat must meet, as best they could, the huge accession of wants that would be created by striving to keep troops alive on the top of the Chersonese Heights throughout a Crim-Tartary winter.

Trusting mainly to their own stores at home not only for articles of equipment and all implements and munitions of war, but also for flour, corn, biscuit, coffee, wine, spirits, and salt meat, they sent out all these things to the shores of the Bosphorus; there established magazines and hospitals, and thus constituted for their armies a secondary base of operations less remote from the theatre of war than the south coasts of France and England.

For the means of land transport, fresh meat, vegetables, forage, and timber, if needed, they trusted mainly at first, of course, to the resources of the countries occupied by their armies; but when the Allied Armies suffered themselves to be penned up upon a small barren corner of ground, there was the anxious task of providing them by sea with everything that they needed, however bulky and cumbersome, so that, when disembarked with great labours from the ships, the freights would not only include huge parks of artillery, and munitions of war, but moreover crowd acres and acres with draught and pack horses and mules, with camels, wagons and carts, and herds and flocks awaiting slaughter, with pyramids of grain and flour sacks, mounds of vegetables, ricks of hay and straw, hillocks of charcoal for fuel, and numberless stacks of timber.

Distressing experience proved that a Government buying things for an army from traders at home may not only have to wait, but in spite of all the money it offers, to go on waiting and waiting during a lengthened period. It took five months to supply our troops on the Chersonese with new tents, and even seven months elapsed before they received the whole number of 3,000 tents demanded in the month of November.

It soon became plain that the whole mercantile shipping of England and France, and of all the neutral countries besides, was insufficient to meet at short notice the growing exigencies of the campaign; so that for long periods together, there were troops, munitions, and stores of all kinds collected for shipment to the East, yet detained at the opposite extremity of Europe for want of vessels to carry them.

For want of means to land or trans-ship goods which had reached their destined ports, they too often remained on board during lengthened periods, and apparently it now and then happened that a vessel left the port she had reached without having completely discharged her cargo, yet continued to go on plying, so that stores

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and munitions long moved to and fro on the waters. The insufficiency of the steam vessels at the command of the British also proved baneful to the health of the troops by curtailing their supplies of fresh meat and vegetables. Then remained the task of landing the stores, disposing them in magazines, drawing them up to the camp, the task of distributing them, and bringing them into due use. For this the French were more happily circumstanced than the British. Their harbours, Kaniesch and Kazateh, no less than the adjacent landing grounds, were so ample and convenient that with the great number of workmen they had at their command, there was nothing to hinder their disembarkation. The regiments had their own bakers with them, and until wounded or stricken by sickness, the French soldier used his own skill and resource in making the very best of his too meagre ration, and his wretched means of shelter. To the English, on the other hand, the advantages enjoyed by the French were all unhappily wanting. They had not sufficient harbours, and Balaklava constituted a very indifferent port of supply for the vast and ever pressing needs of an army.

To facilitate the landing of cargoes, the British engineers in spite of great difficulties managed to construct some wharves. But from the insufficiency of the harbours, and from the want of hands an accumulation of supplies lay for weeks and months on board the ships, some of which had to be kept in the roadstead outside for want of berth-room within.

Soon too a new exigency began to press hard on the Allies, for the enemy had been receiving great accessions of strength, and on the morning of the 25th October he took the offensive at Balaklava. From that day until the 5th November, Inkerman Day, the Allies were under a peremptory challenge, delivered by an army largely outnumbering them and during this critical period of twelve days, there was not, and could not have been, any thought of having roads made by the small number of British troops, which were performing the enormous tasks of besieging Sebastopol, defending Balaklava, and defending the Heights of Inkerman against the enemy's assembled hosts.

Although resulting in victory, the morning of Inkerman Day brought with it so great a disclosure of the enemy's strength that far from lifting off a weight from the minds of the Allied generals, it quickened their sense of the need that there was for preparing resistance to largely superior numbers. And so Lord Raglan began his measures for converting the road by the Col into a "metalled" highway. Four hundred Turks were employed on this task, and the work made fair progress during the few fine days which succeeded the storm of the 14th; but the torrents of rain which afterwards fell, and the sickness and deaths which ensued, proved destructive to the hope

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of completing the work without many more hands. Of the 400 Turks who had at first been employed, only 150 could now be collected, and even these were in too feeble a state to be capable of performing anything like a full day's work. No hired labour worth having could be obtained at this season. The Commissary-General, it is true, was able to hire workmen on the shores of the Euxine and the Bosphorus, and he accordingly imported them by hundreds; but they died by fifties, and the duty of burying them deep enough to prevent their bodies from tainting the air became an additional task. Of course under such conditions the work made small progress; and yet the time had now come when the need of a completed road was most urgent, for torrents of rain were converting the old carriage tracks into a quagmire of tenacious clay. Again and again the irrepressible truth stood forth that the business of the road was one of life or death to many of our soldiers, if not indeed to the army.

The road, growing worse daily under the action of rain, was before long in such a condition as to be impassable for wagons, unless hauled through the clay by powerful teams. The change of draught power to the backs of horses or mules would have reduced the transport power, and yet the number and strength of our baggage horses and mules in the Crimea was being reduced daily and in mid-winter was so low as to be almost on the verge of extinction. Cold, wet, and hard work with prolonged want of food were not only killing the transport beasts, but fast weakening the artillery teams, and Mr. Filder was prevented from importing fresh horses and mules, of which he had numbers in readiness, because he knew that if they were landed, the means of feeding them were not available. Writing on the 29th January, Lord Raglan stated that Mr. Filder complained sadly of the non-arrival of the supplies of hay which he was led to expect he would receive from England periodically. The Commissary-General, on the 13th September, in his official despatch to the Treasury, wrote:—

"BEFORE SEBASTOPOL, 13*th September*, 1854.

"SIR,

Referring to my letter of the (blank) I have the honour to report, for the information of the Lords Commissioners of Her Majesty's Treasury, that the contractors having failed to provide the quantity of hay therein adverted to of proper quality, and under the uncertainty of being able to procure in this country a sufficient supply of forage for the great number of animals belonging to the two Allied Armies, I have the honour to suggest that 2,000 tons of hay be forwarded to Constantinople during the course of the autumn.

"I have the honour, etc.,

"WILLIAM FILDER."

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The Treasury officials, however, did not comply with the Commissary-General's urgent request, but on the 10th October they wrote to Mr. Filder apprising him that it "would depend upon his further reports, whether steps should be taken to send out the hay mentioned in the letter of 13th September"; but at the same time they gave instructions for the despatch of a shipload with as little delay as possible. Until the 7th November no further step was taken; and owing partly to this delay and to the lengthened periods of time spent in finding and loading the vessels, the whole month of October passed away before the first cargo went off. Even to the end of November, the quantity of hay despatched from England's shores "during the course of the autumn" had reached 270, instead of 2,000 tons.

The army of General Canrobert was often, though not always, able to provide itself with good leaven bread, and to this there were added small allowances of rice, coffee, sugar, and salt; but as regards meat the soldiers were poorly fed, so that upon the whole their rations were hardly sufficient to fit them for bearing the hardships of a winter campaign.

The food of the English Army was a subject of anxious and ceaseless care to its chief. In addition to the regulation ration, consisting of either 1½ lbs. of bread, or 1 lb. of biscuit, and 1 lb. of fresh or salt meat, Lord Raglan directed the Commissariat to supply daily to each soldier, as part of his ordinary ration, 1 oz. of coffee and 1¾ ozs. of sugar. Some weeks later, when the health of the army became seriously affected, Lord Raglan, upon the advice of the Medical Department, directed that there should be temporarily added to the daily food of the soldier, 2 ozs. of rice or Scotch barley, an extra ½ lb. of meat, and which was cordially appreciated above all a free ration of spirits. In the winter, for want of land transport the issue of rice was for some weeks suspended, and with the approach of winter, and the exhaustion of the supplies of cattle at Eupatoria, the issues of fresh meat became necessarily less and less frequent, the means of sea transport being wanting. As early as the 24th October, Lord Raglan commenced to obtain fresh vegetables for the British troops in sufficient abundance, but owing to delays in sea passages the quantity brought up to camp in good condition proved constantly less than was wanted for the welfare and health of the troops.

In the autumn, Dr. Andrew Smith recommended that large quantities of lime juice should be sent out, and a portion of this supply, 20,000 lbs. in weight, reached Balaklava on the 19th December, but the medical authorities did not apparently know that they had this resource close at hand, for until Lord Raglan interposed, and by that time scurvy had already proved

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baneful to health and life, no steps were taken for issuing the juice to our soldiers as part of their daily rations.

The French Army was ill supplied with means of shelter, for it mainly used the *tente d'abri*, a low canvas hutch, which is a miserable substitute for the ordinary tent.

Except when unhoused by the whirlwind of the 14th November the English Army was always sheltered by the ordinary bell tents. Still Lord Raglan felt keenly that against the rigours of a winter on the Chersonese, mere canvas would prove a miserably insufficient shelter, and he sent officers to Constantinople, and several ports on the Black Sea, to purchase large quantities of timber, nails, tools, and all the requisites for the construction of huts. But the task of hauling all the timber to the heights of the Chersonese, and converting it into huts was destined to be long retarded by the two great wants oppressing the British Army, want of transport and want of workmen.

An immense supply of all the thick woollen coverings lying on board vessels anchored off Balaklava that seemed best adapted for the soldiers was destroyed by the fury of a tempest. Lord Raglan succeeded in partly counteracting the effects of the tempest by obtaining warm clothes from Constantinople, but the scarcity of land transport between Balaklava and the camp prevented a general distribution.

The administrative arrangements provided for the care of our stricken soldiery were slight, crude, and indeed almost primitive. The London departments provided no efficient ambulance corps, appropriated no well-fitted vessels to the care and transport of our soldiers, sent out no artificers of the kind demanded, refused Admiral Boxer's wise request for a receiving ship at Constantinople. For attendance upon our sick and wounded in hospital, no provision at all was at first made; and in the absence of properly trained hospital orderlies, our people had to rely upon the clumsy old plan of drawing sergeants and soldiers from the ranks for duty as nurses.

Our establishment of hospitals in the Levant extended at one time to the Dardanelles, spreading yet even further to Rhodes as well as Smyrna. For the most part, however, our hospitals in the Levant were established on the shores of the Bosphorus. Of these one for our land-service troops at Koullali received a large number of patients, but by far the greatest part of our Levantine hospital system became concentrated at Scutari.

The supply of things greatly needed for the use of our hospitals was hampered, and for a long time prevented, by the want of decisive authority by those responsible for making the requisite purchases. With the absence of an anterior organization for hospital construction and management, and the want of authority and active

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brain power to make good past neglect, it can scarcely be wondered at that the endeavours to deal with any very large numbers of sick and wounded men was for a long time baffled.

One of the causes which grievously augmented the sufferings and consequent sickness endured by our troops was the excessive work which the siege cast upon them. When great reinforcements had brought up Canrobert's Army to a strength far exceeding Lord Raglan's, it was suggested that there should be a readjustment of the toil endured by the soldiery. Lord Raglan's appeals to the French commander for a re-distribution of the siege labours between the troops of the two Allied Armies did not certainly encounter a complete and final rejection, but they were invariably met by General Canrobert with reasons for postponing the desired relief, and afterwards by delays still more lengthened than the reasons first suggested appeared to warrant. No dilemma more embarrassing to a General could be imagined. On the one side, a certainty that the sufferings of our troops would continue undiminished, and that many lives would be sacrificed; on the other, a grave risk of disaster to the whole Allied Army, resulting from want of concord.*

Under these conditions the Allied Armies, still engaged day and night in a siege which they could not forsake, held fast the bleak heights of the Chersonese, and there, uncomplaining, and loyal, awaited the close grasp of winter.

The Storm of the 14th November.

On the evening of the 13th November, after wild storms of wind and rain, a calm set in which continued until an hour before sunrise on the following day; but then over the open downs on the Chersonese, and the neighbouring coasts, harbours, and roadsteads, there swept a violent hurricane accompanied by thunder and lightning, by heavy rain, hail, and sleet, and followed before the day ended by driving snow.

Of the French shipping, one man-of-war, the *Henri IV.*, one despatch boat, and several supply vessels and transports were lost; but it was upon the British supply ships and the British camp that the disasters fell most heavily. Of the vessels freighted with munitions and stores for our army no fewer than twenty-one were dashed to pieces and totally wrecked, with grievous loss of life, whilst eight besides were dismasted. The *Retribution* (having the Duke of Cambridge on board) had her rudder unshipped, lost two of her anchors, and was long in extreme peril. Even in the little landlocked pool of Balaklava, the shipping there was rudely battered together by the whirling tornado; whilst, moreover, the captains of vessels

* This condensed statement is based upon numerous passages contained in Lord Raglan's Despatches, as well as his private letter.

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which had been lying outside, seized the one hope of saving their craft which seemed to be left them, and lawlessly drove their way in, carrying yet more confusion and havoc into a crashing thicket of bulwarks, and masts, and spars.

On shore no less than at sea the hurricane raged. It tore up trees by the roots, and not only were houses unroofed, but even the vast sheets of metal which covered the naval magazines of Sebastopol were partly carried away. Into the camp of the Allies the tempest at once brought "unspeakable misery." *

The tents not only fell, but many of them were torn to pieces and utterly swept away, with all the things they contained. Affrighted horses broke loose, and fled in all directions until struck down by the whirlwind. Wagons were overturned, and great quantities of food and forage which had been brought up to camp were destroyed or spoilt. The hospital marquees presented so great a breadth of canvas to the fury of the blast that in spite of every effort to uphold them, they were amongst the first tents to fall; and then not only men fit for duty, but the wounded, the sick, the dying, became exposed all at once to the biting cold of the blast, and deluged with rain and sleet.† The trenches were quickly flooded. The soldiers were unable to cook their food, for no camp fires could be lit. To this miserable condition of things no remedy could be applied; for the storm made it hard in the extreme to move from one spot to another, and not only men on foot, but the horses of riders attempting to make head against the blast were again and again overthrown. Under the fall of snow which began when the storm was abating, many laid themselves down without having tasted food, and some, benumbed by cold, were found dead next morning in their tents.

Amongst the twenty-one ships wrecked was the *Prince*, a ship containing everything that was most wanted: warlike stores of every description, surgical instruments, guernsey frocks, flannel drawers, woollen stockings and socks, boots, shoes, greatcoats, and all that the Government could devise for the equipment and comfort of the troops.

The *Resolute*, too, suffered total wreck, and she was the principal ammunition ship of our army. Of the Minié ammunition alone, there went down in her no less than 10,000,000 rounds.‡ The loss of provisions and stores on board other wrecked ships was appallingly great, the hay alone destroyed being in quantities that would have sufficed for all the horses and mules of our army for a period of 20 days.§ That loss of hay was one destined to prove calamitous

* *Journal of the Royal Engineers*, p. 53.

† *Ibid.*

‡ *Ibid.*, p. 55.

§ "Mr. Filder's great fear," writes Lord Raglan, "is want of forage for the horses. He lost 20 days' hay by the tempest."

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beyond measure. Lord Raglan, however, without losing an hour applied himself to the task of providing for the speedy replacement of his lost stores.

The disastrous 14th November was followed by a brief interval of fine weather; and as early as the 18th Lord Raglan intimated that the camps were "wearing a less desolate appearance." But already the sufferings and privations which the storm had inflicted on our troops, were resulting in an increase of sickness; and the horses, too, in great numbers died from the effects of exposure. Lord Raglan's plans for replacing the stores destroyed by the storm were so prompt and well conceived, that they speedily produced their intended effect, but there were some of the losses, and especially the loss of the hay, which no energy exerted from the Crimea could quickly repair. And it is certain that a large proportion of the hardships endured by our army in the following December and January were due to the hurricane of November.

Sufferings of the Armies.

Of the Russians engaged during winter at the war, a great proportion always lived with a roof overhead, some being in barracks in Sebastopol, some housed in neighbouring villages, some in huts, whilst even the troops out on duty, though suffering cruel hardships, had advantages over their enemy in the opposite camp, not only being accustomed to withstand northern winter, but also having behind them a garrison town and an arsenal. The roads broken up by floods of rain however increased their troubles to such an extent that administrative confusion was rife.

The Russians lying stricken with sickness or wounds were at one time 25,000; and the hospital succour in readiness fell so hideously short of the need, that the number of prostrated sufferers exceeded by more than 9,000 the number of hospital berths.*

The French, as compared with our people, enjoyed great advantages owing to their highly-organized system of war administration, their mastery of the art of campaigning maintained by long practice in Africa, the spaciousness of their harbours and landing places, and above all their ample numerical strength.

They used for shelter the *tente d'abri* consisting of separate slips of canvas which by aid of a short, small stick might be raised some 3 ft. off the ground. This in Africa had proved more or less successful but was too frail a thing as a means of protecting troops against the rigours of a Crimean winter and was denounced with indignation and disgust, for the shelter to be found in their dog-tents was only to be gained by crawling on all fours through the frozen or wet mud and snow without, to the mud and wet snow within.

* *Todleben*, Vol. I., p. 705 *et seq*

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Before October had ended, the French War Department brought up or caused to be made a large quantity of warm clothing for Canrobert's troops and as early as the 28th November, a large portion of these supplies was already in camp. But the distribution long remained incomplete. Men in thousands were frostbitten, and many died; whilst of those who survived, the majority were grievously mutilated; and indeed it is declared that but few escaped the sad fate of being maimed for life.*

Without shelter in this severe weather, and also too often unfed, the French horses perished by hundreds; the cavalry were almost dismounted, the artillery and the land-transport trains lost half their teams, and this at a time when double teams were needed for moving even slight loads.

The accustomed rations of the French soldier were scarcely sufficient for any campaign of a kind entailing hard, lasting toil, still less for sustaining him under the hardships of the Chersonese winter. He was from time to time unsupplied with bread. The supplies of fresh meat were not only rare and scant, but of poor quality, while there was no supply at all of fresh vegetables, so that the men had to live upon biscuit and salt meat.

We learn that the admission of patients into the ambulances of General Canrobert's Army were as follows:—In October, 1854, 4,747; in November, 8,990; in December, 6,432; in January, 1855, 9,259; in February, 8,298; in March, 7,737; and in April, 6,323, making altogether 51,786.

It is stated that in the seven months which extended from the 1st October to the end of April, 4,901 men died in the ambulances alone, whilst the deaths in hospital during the four last of these months were 6,557, thus bringing such of the deaths as have not been kept out of sight by the want of monthly returns to the number of 11,458. Within the 20 months November, 1854, to June, 1856, the ambulances of the French, and four only, out of their 23 hospitals, received 23,250† patients afflicted with scurvy.

Lord Raglan's Army at that time was suffering under a great complication of ills. Their outpost duties were always anxious and harassing, their toils with spade and pickaxe fatiguing; but the men who suffered most were the guards in the trenches, often wet through from the first, who had to be sitting all night in postures which cramped their limbs. To such tasks in the middle of winter our men were too often kept no less than five nights out of six. Very often the weary soldier omitted the task of cooking altogether,

* "War appeared in all its horror; men exhausted by illness, scarce protected by a few rags of covering, arrived on the beach to be embarked."—*Rapport Officiale*, p. 76.

† "Dans le mois de Février, le scorbut, prend un developpement considerable, et menace d'envahir toute l'armée."—*Rapport*, p. 81.

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throwing away his salt beef, or bartering it with the French, and eating his salt pork raw, and thus depriving himself of nourishment or taking food in an uncooked or ill-cooked state, becoming an easy prey to disease. Whether by some misunderstanding, or by the paralyzing effect of cold and privation, many regiments were very slow to appropriate the warm clothing provided for them.

The evils affecting our camp kept on acting and re-acting upon each other with a baneful effect; suffering from wet and cold, and deprived of due rest by an excessive burden of duties, the soldier more than ever required wholesome and generous food, but benumbed and tired out with the stress of those very hardships which had made him need such a diet he too often shunned the toil necessary for grubbing up fuel and preparing his ration. Worn down by hard toil and wet, suffering from wants so pernicious as to be too surely followed by scurvy, assailed by cholera, dysentery, fevers, and numberless other complaints, the British army underwent appalling losses day by day.

The whole number of officers disabled by battle or sickness soon became very great, and in some regiments but few remained. The Royal Fusiliers at one time had only three officers left, but it was amongst the rank and file that sickness most destructively raged. On the last day of February the army, out of a mean strength of 30,919 for the month, had no less than 13,608 men lying in hospital. Between the beginning of November and the 28th February we lost in hospital 8,898 soldiers.

From time to time, at this period, reinforcements were landing at Balaklava, yet unhappily did not effect a proportionate and sustained augmentation of the number of men under arms; for the newcomers, all at once subjected to the hardships of the winter campaign, fell sick with great rapidity, so that within a few days, the fresh body of troops became rather a superadded assemblage of hospital sufferers than an actual accession of strength.

Even of the 11,000 men on the Chersonese still able to handle a firelock and keep their names out of the sick list, it must not be imagined that all, or perhaps even a great part, were free from grave bodily ailment; for there reigned in this suffering army so noble a spirit that many, though ill, refused to increase the labours of their comrades by going into hospital. All their hardships officers and men endured with a heroism unsurpassed in the annals of war, and there is good ground for saying, though of course only in general terms, that the men did not choose to complain of the hardships and privations under which they were suffering.

If the soldier had to endure grievous hardship and bodily suffering,

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his General's portion was almost unceasing care, for to Lord Raglan every day of his life and "with dreadful exactness 'the morning state' told all."* His visits to the divisional camps and hospitals impressed him more and more painfully with the extent of the sufferings endured. It was in general by continuous work at his desk that he obtained such distraction from grief as made endurance possible. In the whole multitude of his despatches and letters, general orders, specific directions, memoranda, remonstrances, and minutes that he penned at this time, as stated by the Historian Kinglake, there is not to be found one ill-aimed appeal, one random or misapplied word, one statement disclosing confusion or obscurity in the mind of the writer.

When the sick were carried down for embarkation to the port of Balaklava they often endured long delays and consequent sufferings, which however perhaps in most instances could be traced to want of hands and of space. No adequate arrangements had been made by the Home Government for removing them in vessels which were either sufficiently spacious, or properly equipped for the purpose; and although they had only to traverse a distance of some 300 miles, the privations and hardships they endured while making the passage, proved often such a cruel addition to their original sufferings that, during the months of December and January respectively, they died in the proportions of 85 and then 90 per thousand.

During a period of only seven months from the 1st October, 1854, to the end of April, 1855, out of an average strength of 28,939, there died in our hospitals, or on board our invalid transports 11,652 men, 10,053 from sickness alone. Of these misfortunes the causes were:—With the French, a scanty allowance of meat and a miserable kind of tent. With the English, excessive toil, an interruption of the land-transport power, resulting in many privations; and a grievous inadequacy of the means required for watching over the health of an army and tending the sick and wounded. The evil lay—not alone, and not even capitally—in the want of better means for facing a rigorous winter, but rather in the ugly predicament of having to winter at all without long antecedent preparation on bleak, open downs in Crim-Tartary.

In war, as we all know, dire predicaments result often from defeat; but here, strange to say, it was by the joyous path of victory that the Allies placed themselves to meet the winter on a high, barren promontory, without even a hope of keeping themselves alive unless by means brought them in ships from many and distant shores.

* The Quartermaster-General before the Chelsea Board, p. 171.

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Improvement in the Health of the English Army.

However, towards the end of February, matters began to improve. Owing to the assistance of a fund called the "Crimean Army Fund," administered by two honorary agents, Messrs. Tower and Egerton, an immense quantity of stores of every description were sent out from England, and a thousand tons of goods were sent out to Kadikoi, the chosen site of their magazines, somewhat more than a mile from the beach. Owing mainly to the skill and energy with which Tower and Egerton worked, and to their tact and good feeling, our army responded to their exertions in a spirit described as one of "universal goodwill." The thousand tons of gifts altogether are believed to have represented a value of about £60,000. The moral effect of these offerings upon the mind of the soldier was good beyond measure, showing the sympathy that united our people at home to their suffering army abroad. The advance towards good health went on steadily down to the close of the war. Computed in proportion to force, the decrease since January, 1855, in the number of admissions to hospital became so great during the last month of the occupation of the Crimea in 1856 that it might be indicated without very large error by a ratio of ten to one. So its numbers slowly augmenting, its toils at last happily lightened, its wants almost all supplied, the army regained health and strength.

THE SIEGE OF SEBASTOPOL FROM NOVEMBER 6TH, 1854, TO FEBRUARY, 1855.

The Allies, as it has been shown, having given their adversaries the priceless respite they needed for the Flagstaff Bastion, and not judging the Sebastopol front to be anywhere else in a state that would warrant assault, now found themselves committed to what seemed destined to prove a long siege.

Instead of approaching their object with that huge preponderance of numbers, before Vauban's time ten to one, which science had declared to be needed for the reduction of a fortress, they were, on the contrary, outnumbered by tens of thousands; the Allies had confessed themselves unable to invest the fortress on the north, whilst even on the south they were leaving the enemy free to come in or go out as he chose.

By a part of the Russian Army on their flank, and the garrison of Sebastopol entrenched along their whole front, the Allies had allowed themselves to be completely hemmed in on the land side. So long as they had been able to hope that within a few days they would break their way into Sebastopol, the delay suffered would be regarded as only a brief restraint to be followed by a dazzling conquest, and an end to all their troubles; but the moment they had resolved that the crisis of their enterprise should be indefinitely put off, the Chersonese on which they had alighted, as

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though it were simply their stepping-stone, seemed thenceforth to be their prison. With their parallels, "first," "second," and "third," and all their siege apparatus, they still had the air of assailants, yet were not in reality minded to risk striking any prompt blow; and on the other hand, they were subjected to whatever might be adventured against them by an army which they could not shake off, and also by the garrison of a fortress which they had not even tried to invest. Whatever might be the difficulty of forcibly reducing Sebastopol, an undertaking to withdraw the Allies, and to cover their embarkation, would have been still more formidable. and must have proved an utterly desperate task.

Imagining that the enemy might some day renew his great enterprise of the 5th November, the Allies constructed, armed, and maintained defensive works on Mount Inkerman; threw up works of countervallation on their left; perfected the eastern and north-eastern defences of Balaklava, and even strengthened yet further the hardly assailable lines which crested the Saponnè Heights on General Bosquet's front. Thus self-defence entered into the motives which impelled the now harassed Allies to toil day and night at their works.

It was still by the Flagstaff Bastion that the French were at this time hoping they might some day break into Sebastopol. They did not indeed try to lessen the distance of some 180 yards which parted their most advanced trench from the counterscarp of the opposite bastion, but they did their utmost to perfect the third parallel opened on the 3rd November, and prepare to break down by over-dominant metal the fire that threatened to rage against any column advancing to storm and capture the work.

As is usual with besiegers when prevented in their task of pushing forwards "approaches" by trench work, the French with great diligence resorted to the expedient of mining. They also by degrees saw that their own special task must include a great extension of siege-work towards their left. They therefore not only made ready to deal with the Flagstaff Bastion, but became step by step the besiegers of all the Sebastopol Front from the line of the Wironzoff Road to the edge of the Quarantine Bay. To maintain, to improve, and a little advance their approaches, to confront with new batteries an enemy ever restless and aggressive in his use of the pickaxe and spade, and finally to prepare for the object of supporting the French on their right, was all that in the way of siege work the British were able to do. They did no less than their utmost; yet in face of the mighty defences piled up before them, could not at all make sure that they would be able to win for the French such immunity in the direction of their right front as was given them on the 17th October, when under the fire of our guns the Malakoff Tower was silenced, and the Great Redan lay in ruins.

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The strain upon the fortitude of our army by the exigencies of siege work and continuous strife with the enemy, superadded to the task of living or painfully trying to live, was excessive. In the midst of its most grievous straits for want of other means of land transport, one might too often see hundreds of our weary soldiers, every man of them heavily laden, painfully employed in carrying up the supplies over miles and miles of deep quagmire, whilst also at the very same time might be seen on the track by Karani a team reckoning no less than from thirty to forty of our few surviving horses, engaged in dragging up to the front by ploughing through depths of clay some mighty gun intended for the all-demanding siege.

Whilst the suffering and hampered Allies could employ workmen only by hundreds, the Russians kept engaged on their works an organized body of labourers with a varying strength of from six to ten thousand; and if it be remembered that the enormously constructive sources thus possessed by the garrison was wielded by Colonel de Todleben, some conception will be formed of the inferiority in working power which kept down the Allies.

It was with these vast advantages, wielded by consummate genius, that the formidable colonel of Sappers proved able to work his wonders. Not even neglecting that quiet and unmolested "North Side" which a less wary man might have judged to be exempt from all risk, he converted Sebastopol into a mighty fortress prepared for the fight at all points, and defended on the land side alone by great guns already numbering 700, beside all the lesser artillery, held ready at every apt spot to confront storming parties with round shot, and volleys of mitrail. He closed the gorge of the Little Redan, and of the Malakoff, and afterwards that of the Flagstaff Bastion. To make sure that the French would meet with destruction in event of their carrying the Flagstaff Bastion, by means of underground wires he connected the powder magazine of the work with a peaceful spot. As regards the French mining operations, Colonel de Todleben met them by countermines.

By all the works thus accomplished did the great engineer make his fortress secure against any attack the Allies might attempt. But he did not so believe; he believed that with all his resources he could not defend the threatened bastion against a determined attack; whilst moreover he judged that the loss of the work would so split the Sebastopol defences as to ensure the fall of the place. But short of undertaking great sorties, Colonel de Todleben did all that he could to conduct his defence of Sebastopol in an eagerly aggressive spirit, and one might say that he manœuvred with earthworks as others manœuvred with troops.

Another way in which de Todleben maintained his aggressive defence was by sinking and maintaining "rifle-pits." So vexatious a kind of encroachment was not always to be maintained without provoking

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resistance, and the struggles for rifle-pits occurring in the course of the siege began with the exploit of young Lieut. Tryon, who wrested one of these from the enemy, and thereby won warm praise from both the Allied commanders. de Todleben also caused a sufficing breadth of ground to be scientifically chosen and duly taped out by skilled engineers, then delivered under cover of night, to strong working parties, who would instantly and swiftly entrench it. All this he saw could be done; and thenceforth the besiegers had cares which resembled in some sort those of people besieged; for too often the morning disclosed a small bit of what might be called a counter-parallel; and these lodgments soon became oppressive beyond measure. It was on the French, for the English approaches had been less closely pressed, that the lodgments especially frowned.* The explosion de Todleben effected on the 9th February did the French no physical harm, but he was convinced that by the vigour of his countermining operations, he caused the French to mistrust every foot of ground upon which they must tread when marching against the Flagstaff Bastion, and in that way did much to deter them from ever assaulting the work.

There was no resort during the winter to powerful sorties, which, as some able critics thought, the Russians ought to have hazarded, but of small sallies, ventured at night, the garrison made frequent use, so that owing to the hostile pressure which Todleben was always applying the guards of the trenches were constantly kept on the alert.

Another expedient used by the Russians seemed one less meant for the exigencies of actual fighting, than as one for dealing with soldiers surprised, confused, and distracted by a sudden incursion at night-time. At one time they certainly used the lasso, and also the gaff, or some tool resembling a boathook, as their means of first upsetting or otherwise arresting an adversary, and then so pulling him in as to be able to make him a prisoner. This abhorred innovation was so highly resented by the French that General Canrobert, under a flag of truce, made it a subject of complaint addressed to the Russian authorities; and in a magnanimous spirit of concession, General Osten-Sacken, commanding the garrison, put an end to the practice.

Burgoyne all this while had not ceased to insist that the Malakoff Front was the one more than all others meet for attack and had put forward counsels to that effect. In the face of our dread "Morning States," and the absence of any English succour approaching, he long clung fast to a hope that the honours of attacking the work which he held to be the all-mastering key of the position might accrue to his fellow-countrymen, and even when forced to see that no heavier share of siege work could be laid upon our people, still

* Out of 34 lodgments, which at one time were counted, two only menaced the English.

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tried to find a way, by proposing that Canrobert's troops should relieve the British infantry from the task of supporting the Left Attack, and that with the force then set free Lord Raglan should undertake the Malakoff.*

It was on the 20th November that the French had begun to push forward their great mining enterprise, and they had thenceforth conducted it with unwearying energy, their first design being to surprise the enemy by effecting an explosion under the Flagstaff Bastion. Unenlightened, it seems, by either spies or deserters, they worked their way forwards, moving their earth-trucks to and fro. Such work has always to be carried out with every precaution for minimizing noise which can be detected at a considerable distance, and at times located with some accuracy. The foe whom they had challenged by entering on this underground warfare was perhaps one more thoroughly practised, more highly skilled in its mysteries, more eager to use his resources, than any other man living; † and before they had burrowed their way to the ground required for their purpose, an enemy like themselves, subterranean, but silent, unheard, unsuspected, was awaiting them in his listening galleries.

The great engineer scarcely awaited the reports of deserters; for when he saw that the French did not push their approaches beyond the third parallel, he inferred that they would try to work their way underground, and he resolved to meet any such enterprise by a vast system of countermines. At length, on the 30th January, the expected reward of long toil was attained, for then Colonel de Todleben learnt that at the extremity of one of his listening galleries the French could be heard, and he was even able to assure himself that they were piercing ground on a level with that to which he pressed his keen ears when listening for signs of their presence.

In the strife between miner and counterminer, he who first hears his antagonist obtained the ascendant. Todleben with a great self-restraint determined that before he assailed them he would let the French burrow still closer, and thus so reduce the thickness of the interposed clay as to give him the means of overwhelming them by an explosion of only moderate strength.

At length on the 3rd February, the fourth day after the one when the miner's approach was first heard, Colonel de Todleben fired a camouflet, which left undisturbed the whole surface of the ground overhead, but tore its way into the gallery where the French had been heard, killing two of their men as it passed and visibly finding its issue in the open air through ground behind their third parallel, thus showing him where lay the entrance to their system of mines.

* *Journal of the Royal Engineers*, pp. 63, 139.

† At one period of his life General de Todleben had devoted himself with the greatest zeal to the science of mining and at that period a very large proportion of his time was spent underground.

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The French chief engineer, however, hoped that they might still draw advantage from their system of underground approaches on which much labour had been expended, because it would enable their miners to open up a line of craters which might afford cover, and perhaps made the beginning of a fourth parallel. He therefore by an explosion threw up one crater of moderate size, but it was seized and crowned and definitively held by the Russians, and the second design of the French being thus defeated, it resulted that so far Colonel de Todleben obtained and kept his ascendant at the seat of the underground war.

The works of defence on Mount Inkerman were by this time complete; and of those which from the first had remained in charge of the British they continued to hold; but the bulk of our troops on the Chersonese lay henceforth compactly disposed between the 2nd French Corps on their right and the 1st French Corps on their left.

Acting in concert, in so far as was possible, and each making good the other's deficiencies, the French and the British Armies began to fulfil the conditions laid down on the 1st January, and constructed two batteries which by means of flanking fires were destined to aid our Allies in their meditated attack on the Malakoff.

After his defeat at Inkerman, General Dannenberg was removed from the command of the 4th Army Corps, and replaced by General Osten-Sacken, and amongst those "reorganizing" directions, which General Niel had brought out, there was one which removed General Forey from the command of the 1st Corps d'Armée, and entrusted it to General Pellissier—an officer destined to reach, though not until some months afterwards, a yet more exalted position.

Under the directions of Lieut. Stopford, of the Royal Engineers, our people in the beginning of December constructed an electric field telegraph; and towards the close of the same month, Mr. Campbell, a civil engineer, began his operations for making the railway between Balaclava and the camp. In December the command of our fleet passed from Admiral Dundas to Admiral Sir Edmund Lyons.

Although in a measure disorganized by the bloody defeat sustained by the Russians at Inkerman, and by the immense loss of officers, yet so high was the spirit of their people, and so great the firmness, the skill, and the resource of the engineer then directing their energies, that far from yielding to depression, they carried on the defence which almost undid the curse of defeat, and so bore themselves that, after a while, they stood, as some thought, in less jeopardy than the baffled victors of Inkerman. It might indeed have been said of the besieged and the besiegers that during several months each lay at the mercy of the other.

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Eupatoria.

Although up to the middle of the month of February, 1855, the Russians may perhaps be said to have obtained some ascendancy in the siege operations before Sebastopol after their defeat at the Battle of Inkerman, they suffered another reverse at Eupatoria, where they were repulsed by the Turks in an attack made on the city of Eupatoria on the 17th February, 1855.

The seaport town, Eupatoria, had surrendered to Admiral Lyons in the earliest hours of the invasion, and the Allies thus established close and friendly relations with not only the people of the town, but also their country neighbours. These countrymen, however, soon found that they were dangerously circumstanced, and when the Russian cavalry came near their homesteads, they hastened to fly from the imagined wrath of their Czar, took shelter within the town, and pastured their flocks in its neighbourhood.

Russian cavalry after a while drew a cordon about Eupatoria on its land side, and took care to maintain it so closely that the flocks in their neighbouring pastures were no longer safe against capture. Some ten thousand head of cattle, which would otherwise have furnished good meat to our suffering troops on the Chersonese, were seized instead by the enemy, and driven off into his camp.

Upon learning that General Khrouleff had carefully explored the ground, and considered it possible to take Eupatoria without grave losses, Prince Mentschikoff not only made up his mind to have the enterprise tried, but to have it conducted by one who, directly in the face of judgment pronounced by his immediate chief (Baron von Wrangel), had formed a counter-opinion, and imparted it to the Commander-in-Chief.

Thus it happened that on the morning of the 17th February, the Russians made a vigorous attack, opening their fire against the defences of Eupatoria with 76 pieces of cannon. It completely disabled one Turkish battery. It killed Selim Pasha, struck down another general and 19 men, brought about several explosions, and the town at last slackening fire seemed to own itself ripe for the assault. In columns of companies two of the chosen Azoff battalions moved forward. They approached to within some 25 yards of the ditch, but were then beaten back by the fire of the place. Soon, however, they rallied, and were advancing once more when stricken again by the fire from the parapet they again began to fall back.

And now a Turkish battalion pressed forwards with bayonets fixed, sprang on the beaten columns retreating across its front, and pushed them northward, and preventing them reaching shelter. With some 200 horsemen, who constituted what was almost the whole of Omar Pasha's landed cavalry, Iskender Bey trotted up on the flank of the beaten battalions, cut them off from the shelter of the Russian burial-ground, and pressed their retreat in

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the open till one of them, formed up at last in a hollow square, was able to stop the pursuit. The Russian loss was put at 760, and that of the garrison at 387.

This repulse might seem only a trifling discomfiture, yet (as oftentimes happens in war) was destined to gather some weight from the fact of its proving conclusive. From the moment of Khrouleff's retreat to the end of the war, Russia always acquiesced in the briefly-delivered arbitrament of the 17th February, and thenceforth left to her foes the absolute, unchallenged ownership of Eupatoria, which by many was believed to be the true key for laying open Sebastopol.

Although the little discomfiture thus sustained by the Russians was only of the kind that soldiers call "a repulse," the Czar Nicholas felt it acutely. By relieving Prince Mentschikoff of the command, he perhaps found some vent to his feelings, yet could not allay his anguish, and continuing to grieve, he fell ill.

The bare sequence of facts ran thus:—The Czar's troops were repulsed by the Turks on the 17th February; the telegraph soon told him the truth; and he died on the 2nd March.

(*To be continued*).

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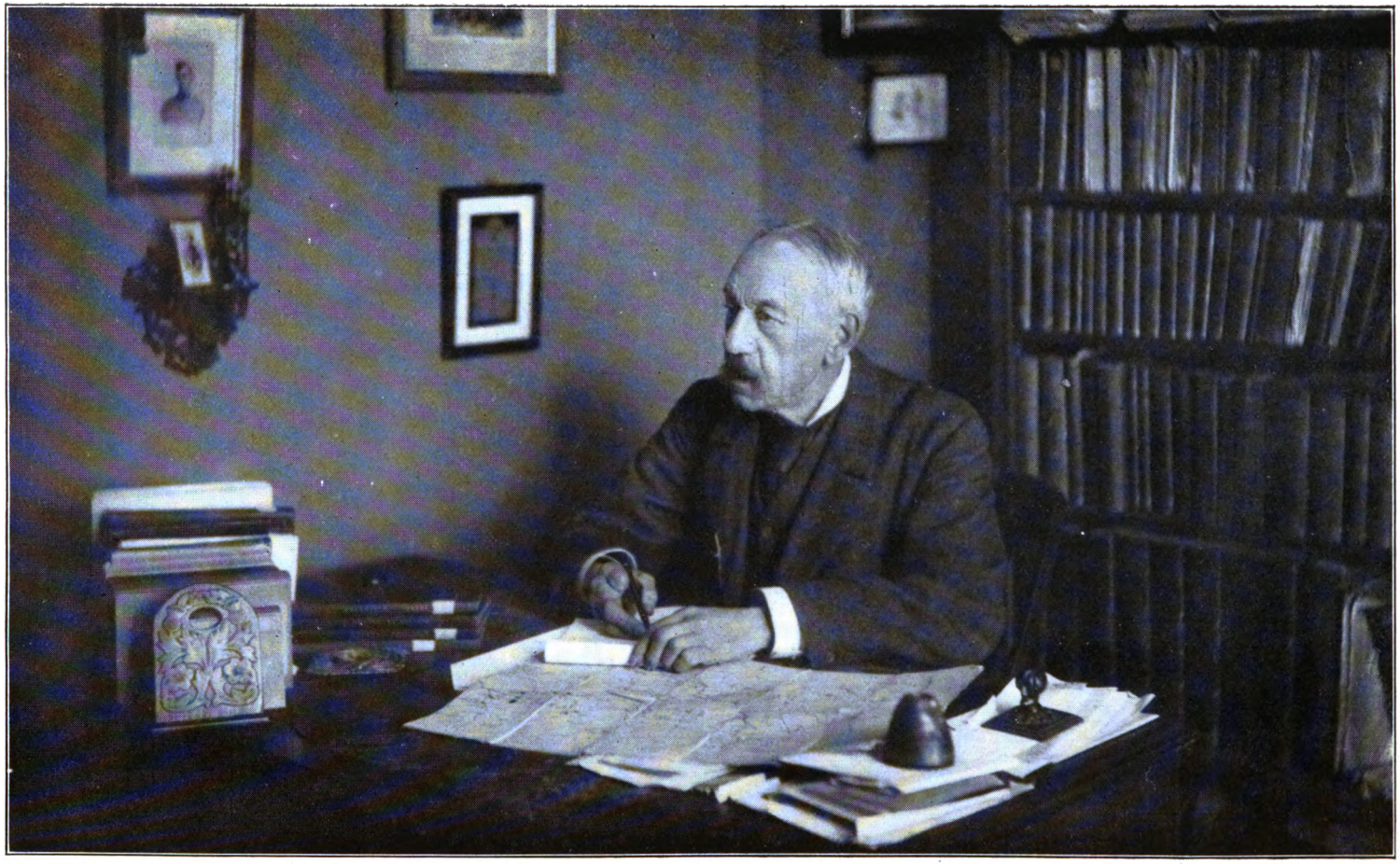

Colonel Sir LONSDALE HALE, Late Royal Engineers.

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MEMOIR.

COLONEL SIR LONSDALE HALE.

MILITARY ENGINEERS have a wide field to cover. They are bound to specialize and have not much leisure to study the art of war as a whole, still less to write about it. Yet it cannot be said to be no concern of theirs when we have an Engineer officer as our War Minister, and another is commanding all the armies of France. It is well, therefore, that among the chief educators of the Army in the course of the last half century, the Corps can claim two—Charles Chesney and Lonsdale Hale. At Chesney's death Hale spoke of him as "one of that band of writers who have of late years striven so hard and so successfully to provide for the British Army a supply of sound military literature" (*R.E. Journal*, April, 1876). But he was under fifty when he died, and had not time to gain that far-reaching influence which Hale acquired by half-a-century of indefatigable work.

Lonsdale Augustus Hale was born at Charterhouse on 11th May, 1834. He was the fourth son of William Hale Hale, Archdeacon of London and Master of Charterhouse (*v. Dictionary of National Biography*). John Lonsdale, afterwards Bishop of Lichfield, was his godfather. He was educated at Charterhouse and Woolwich, and was commissioned as 2nd lieutenant in the Royal Engineers on 21st December, 1853, being second in his batch. He became lieutenant on 21st March, 1854. At the end of that year he was sent from Chatham to Alderney, and in May, 1855, he was ordered to the Portsmouth district, which seems to have included Aldershot at that time. He was employed in the construction of the camp at Aldershot, and contributed some memoranda on stabling to Vol. VII. of the *Professional Papers*. He took part in amateur theatricals there, being an excellent comic actor. The Queen was present at one performance, and was so much amused that she caused him to be presented to her. In doing so, General Knollys assured Her Majesty that the young officer was as good at work as at play. He had joined the newly-formed A Troop of the R.E. Train when it returned from the east, and served with it at Aldershot and Chatham alternately. Colonel G. Philips, his close friend from those days, writes: "Shortly after my return invalided from the Crimea, I was

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ordered to Aldershot. The R.E. were then in lodgings, and on my arrival I looked up Hale, *then a stranger to me.* I suppose he saw that I was very weak and pulled down, for he insisted on my occupying his bed while he slept on a sofa ; a good practical Samaritan."

On 13th January, 1859, Hale was married to Emily, daughter of Hugh Hamersley, of Pyrton Manor, Oxfordshire. In the following month he went on foreign service to Corfu. On 10th May he was promoted 2nd captain. In July he was ordered to Gibraltar, where —with the exception of six months of sick leave—he remained till January, 1862, when he took up an appointment as Instructor in Fortification at Sandhurst. This was the beginning of his long career as a teacher. He remained at Sandhurst 8½ years. He threw himself heartily into the life of the place, took part in Staff College theatricals, and was devoted to cricket, though an injury to his right hand while rabbit shooting disabled him from playing. Charles Kingsley, then Rector of Eversley, was among his friends.

In July, 1870, when garrison instructors were introduced, Hale was made garrison instructor for the S.E. District, and three years afterwards he was transferred to the Home District. Notes of some of his lectures at Dover and Shorncliffe were printed under the titles, *Principles of Outpost Duty* and *What to Observe and How to Report It.* The latter went through several editions. It sprung from talks to the officers and N.C.O.'s of two cavalry regiments at Shorncliffe on the art of reconnaissance. After the Sudan Campaign of 1884–5, Colonel Percy Barrow, of the 19th Hussars, wrote from Dongola to tell him that the brilliant reconnoitring work of the regiment during the desert march was entirely due to the seed he had sown. He had become regimental major on 5th July, 1872.

At the beginning of 1874 he was appointed Instructor in Military Law and History at the S.M.E., Chatham, where up to that time there had been no provision for the teaching of those subjects. In the summer General Sir Alfred Horsford went to Brussels as British representative at the Conference on the Rules of Military Warfare ; Hale (who had served under him at Dover) went with him as Assistant Military Secretary, and received the thanks of the Foreign Office for his services. When the work of the Conference was over they visited some of the battlefields round Metz. In the course of the next 20 years Hale frequently revisited these and other battlefields of the war of 1870–71, taking parties of officers with him. After one of these visits he was presented with a goblet inscribed "Lonsdale Hale, from his nine pupils, 1889, Weissenburg-Sedan," with their names added, Lord Wolseley, then Adjutant-General, and Sir Evelyn Wood, then commanding at Aldershot, being among them.

It was a fortunate thing that he had exchanged the teaching of fortification to cadets for a wider field of military instruction on the

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eve of the Franco-German War. That war at once riveted his attention and was the subject of unremitting study for the rest of his life. In February and March, 1875, he gave in the *R.E. Journal* a summary of the best literature then available on the war and its lessons. In 1877 his *Tactical Studies of the Battles of Colombey-Nouilly and Vionville* was published officially. They were examples of what was then a new method of describing a battle, following it step by step as at Kriegs-Spiel, and aiming at scientific precision rather than artistic effect. He helped Major F. C. H. Clarke with the proofs of his translation of the German Official History of the War, published in 1874–84, and he supplemented that work in 1890 by an Analytical Index, a most laborious task. He joined the United Service Institution in 1871, and in 1876 he took charge (as honorary editor) of a new section of the Journal, devoted to articles on foreign professional subjects and to notices of professional books. These "Occasional Papers" gave new life to the Journal, which had hitherto been a mere report of lectures given at the Institution.

After four years at Chatham, Hale returned to his old neighbourhood, being appointed Professor of Fortification and Artillery at the Staff College on 1st February, 1878. He went to South Africa in the summer of 1879 for the second stage of the Zulu War. He saw no fighting, being placed in charge of the Port Durnford base as A.A. and Q.M.G. He had to keep in touch with Fort Pearson and with the First Division in Zululand. He had also to see to the landing and embarking of troops and stores, and so it fell to him to embark Cetywayo in September. He received the medal and clasp for the war, and was back at the Staff College in November.

It was a great disappointment to him that he had no part in the Egyptian Campaign of 1882, but his rank was against him. He had become regimental lieutenant-colonel on 1st October, 1877, and colonel in the Army four years afterwards, and posts for full colonels were scarce. Seeing no prospect of realizing his hopes of active service, he gave up his professorship and retired from the Army on 1st August, 1883, much to the regret of his friends. Sir Herbert Stewart pressed him to reconsider his intention: "That you, whom I beg all my friends to go to the Staff College specially to hear, and learn what soldiering is, should leave, seems to me downright wicked."

But there was to be no such waste of Hale's "splendid energy" and knowledge of warfare as Stewart feared. In fact a wider field was opened for them. He set himself to help everyone who wished to learn the art of war; and he preached the truth as he saw it, whether men would hear or whether they would forbear. He did not leave Camberley, and remained in touch with our chief military centre. He often lectured at Aldershot, and three of his lectures were printed in the series of the Aldershot Military Society. Among

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them is "The Fog of War," a happy phrase which has passed into common currency. He defined it as the state of ignorance in which commanders frequently find themselves, and illustrated it from the action at Kissingen (10th July, 1866) between the Prussians and Bavarians. The lecture was given on 24th March, 1896, with Lord Wolseley in the chair.

But he did not confine himself to Regular soldiers: he did his best to improve the Volunteers. Towards the close of 1884 he gave a series of "Talks on Tactics" to the Inns of Court Rifles. He told them freely of their shortcomings, declaring himself a believer in the probability of invasion and in obligatory service for home defence; but he spared no pains to increase the efficiency of the force as it stood. In the course of the next 20 years he lectured to Volunteers in all parts of the country—in Sheffield and Manchester, Edinburgh and Glasgow, Cardiff and Oxford.

In 1885–6 the Home District Tactical and War Game Society (afterwards the H.D. Military Society) was started, to give officers of Militia and Volunteers means of study and practice. Hale undertook the duty of Umpire-in-Chief at the War Games (or Exercises, as he preferred to call them), and he carried it on till the society came to an end as a consequence of Mr. Haldane's changes. One of its original members, Colonel Sir Howland Roberts, writes: "Officers of all ranks of the Services came to hear the rulings and criticisms of our Umpire-in-Chief, which were so clear and evidently those of a master that such a thing as questioning his decisions was unknown. Not only did Colonel Hale draw up the general and special ideas, criticize the appreciations and consequent orders, involving heavy work, but often he would ask the combatants and lookers-on to meet him the following Saturday on the terrain where the battle had been fought on the map, so as to realize how the actual features of the ground would affect real troops."

Another Volunteer officer, Lieut.-Colonel A. K. Fletcher, writes: "He was by far the strongest Director I ever came across. One always felt the electricity of his presence in the room, and on the rare occasions when he was unable to be present there seemed a lack of 'go.' Of few words or even blunt, he was always fair and most helpful to young officers. . . . Indifference rather than ignorance was his pet aversion, and on occasions when he thought it necessary he had a very caustic tongue. He would never allow a scheme to be spoilt by faulty leading, and on such occasions he was always ready with fresh orders, pinning down the wanderer to the right path."

During all this time he was busy at the United Service Institution. He continued to edit the "Occasional Papers" for some years. He was made a member of the Council in 1884, and remained on it almost without a break till his death, becoming Chairman of it in

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April, 1913. He was Chairman of the Journal and Library Committees from 1895 to 1913. He took an active part in the preparation of catalogues of the Library. In 1908 he arranged the military maps and plans, and in 1913 he arranged and catalogued the military manuscripts. In that year he was awarded the Chesney Gold Medal, "in recognition of his long connection with home and foreign military literature." In moving a vote of thanks to him at the end of his year of office as Chairman, Lord Methuen said that there was no officer to whom the British Army owed more, if so much. A portrait of him, painted by Colonel W. C. Horsley, V.D., hangs in the Institution.

The lectures and articles by him which are printed in the *Journal* deal with the new French infantry tactics (1876), the French Army (1883), changes in the drill of the German Army (1889), outposts (1881), infantry fire *versus* artillery fire (1883), supply of ammunition to armies in the field (1884), tactics as affected by field telegraphy (1887), operations in woods (1897), and end with a personal appreciation of Lord Wolseley (1913). There are also two lectures which are of particular interest, as they give his creed on the teaching of military history:—"The Study of Military History by the Regimental Officers of the Army" (1876) and "The Professional Study of Military History" (1897). In the former he urged regimental officers, instead of reading Napier, to take the most recent war, and study it with the help of the German Staff History. They should go to documents, not to essays, select particular actions (such as the Storming of the Rotherberg) and make themselves thoroughly acquainted with every detail. He took the same ground 21 years later. He complained that cadets carried away false impressions from the Napoleonic Campaigns, because of the change of weapons. The professional study of military history should be purely utilitarian, aiming to make the soldier a better soldier; it should be suited to the rank of the officer and the work before him; and it should run chronologically backward, not forward.

In the discussion which followed this lecture, Colonel G. F. R. Henderson objected to exclusive devotion to the War of 1870, and held that, as regards strategy, British officers could learn more from the American Civil War and from Wellington's Campaigns. The Chairman (Sir William Butler) also favoured breadth of study, remarking that the accounts of recent wars are sure to be unfair and distorted. This drawback was recognized by Hale himself in a paper written for the Historical Congress of 1913, on "The Difficulties Encountered in Compiling Military History." There he described the German Staff History as "a marvellous example of *suppressio veri* from beginning to end," not as regards the events, but as regards the German leaders concerned in them. He pointed out that owing to this reticence, and to want of data from the French

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side, there was no full account of the Battle of Gravelotte till 36 years afterwards.

A singularly ready speaker and writer, he was more concerned with practical ends than about his own literary reputation, and most of his work was occasional. But in 1904 he made his chief contribution to military history in "The People's War in France, 1870–71," a masterly account of the attempt and failure of Gambetta's armies, or rather of those operating from the Loire, to relieve Paris. He thought that British officers have more to learn from this phase of the war than from the earlier phase which ended at Sedan. He supplemented this volume later by two articles in the *Edinburgh Review*, on "Bourbaki's Campaign" (July, 1910) and "Gambetta's War Office" (October, 1911), based on recent publications of the French General Staff.

For three years after his retirement he was an Army coach, but he found the work distasteful. For nearly 20 years, from 1888 onward, he was a military examiner, and took part in examinations of officers for promotion, candidates for the Staff College, Militia officers and cadets. Few men have had such varied experience of teaching. He was one of the witnesses called by the Akers-Douglas Committee, which reported on military education in 1902, and his evidence, which occupies several pages of the Minutes, states his views on the subject in his usual clear-cut fashion. He reviewed the Report of the Committee in three articles in the *Pall Mall Gazette*. When his work in this line was over, he wrote some "Notes on the Marking of Examination Papers," full of shrewd suggestion. They were officially issued by the War Office at the end of 1910 with the intimation that they were "the ripe fruits of experience gained by many years of conscientious work as an examiner."

The short notice of Hale in *The Times* of 26th October mentioned that he was a constant and valued correspondent of that paper for a good many years. From 1890 onward he wrote series of articles on the annual manœuvres, especially the cavalry manæuvres, and on other military topics. During the South African War he wrote on "Lessons of the War," "Lord Roberts' Campaign," "The Cavalry in South Africa," and "The Cavalry in Natal." The articles were usually headed "From a Military Correspondent" or "From an Old Soldier," but his letters were signed. The latter dealt with a great variety of subjects; they were full of pith and marked by a dry sardonic humour. He wrote a good deal in the leading Reviews. Two of his articles in *The Edinburgh* have been already mentioned; another, on "War as a Teacher of War," appeared in April, 1902. A complete list of his articles cannot be given here, but those which he wrote for *The Nineteenth Century* will serve as a sample:—"Professional Ignorance in the Army" (September, 1887), "Das I. Garde-Dragoner Regi-

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ment" (September, 1889), "The War Game" (February, 1891), "An Army without Leaders" (March, 1896), "Our Peace Training for War" (February, 1900), "The Home Generals and Their Work in the Coming Autumn" (July, 1900), "The Staff Work in the War" (September, 1900), "Sham *versus* Real Home Defence" (February, 1901), "The German Order of the Iron Cross" (October, 1901), "Our Pitiable Military Situation" (July, 1904), "The Insecurity of our Home Defence To-day" (August, 1908), "Watchman, What of the Night?" (December, 1908), "Forewarned, but not Forearmed: A Warning from 1870–71" (June, 1909), "Home Defence 'Unrest'" (October, 1910), "Compulsory Service: A Minister's Manifesto" (February, 1911), "Up and be Doing" (December, 1911).

It will be seen from the above list that as time went on the warning note became more pronounced. He was fully alive to our "peril from over the way," as he phrased it, and was unsparing in his efforts to bring it home to his countrymen. To reach the working man he wrote a series of articles in *The People*:—"Look Out for Trespassers: A Warning to Britishers." In 1910 he issued a pamphlet on "The Horrors of War in Great Britain," based on the experience of France in 1870. At the end of 1911 he had a long letter in *The Times*:—"The Question for the Nation on New Year's Day, 1912." He had no faith in the Territorials. At a meeting at Camberley in 1908, called to support the Territorial Force, he disconcerted the promoters by making an impassioned speech on invasion, and following it up with an amendment in favour of compulsory service, which was carried by a large majority. Yet he would not join the National Service League, as he thought its programme inadequate, and would accept nothing short of a year's training for recruits. Compromise was not much to his mind.

With so many irons in the fire Hale had little time to spare for local affairs; but in April, 1900, being dissatisfied with the way in which they were carried on, he stood for the Frimley Rural District Council, and was returned at the head of the poll. He served his term (three years) and proved a very capable Chairman of the Sanitary Committee. At the first meeting of the Council after his death the Chairman said:—"In my humble opinion he was unique, and his loss leaves a gap which will not be filled. No appreciation that I could utter could do justice to that life crammed full of noble service and kindly actions . . . he was on a pedestal in our hearts." He endeared himself especially to officers at Camberley, for he was always ready to help those who consulted him in any difficulty, and grudged neither time nor trouble. There was general satisfaction when he was knighted at the time of the Coronation of George V., the only official recognition of the country's debt to him.

Hale had one son and three daughters. The son, William Alfred Lonsdale, born in August, 1876, passed with special distinction

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through Sandhurst and was an excellent draughtsman. He joined the Northumberland Fusiliers in 1896, served in the Sudan Campaign of 1898 and was present at the Battle of Omdurman; but he died of enteric at Alexandria on 15th October. Hale arrived there a week too late. The loss of his only son was a heavy blow to him, and was followed by the loss of his wife on 13th January, 1903 (their wedding day). In 1905 he withdrew from the Athenæum of which he had been a member for 30 years. In the early part of 1914 his health and strength began to fail. When the European War came in August he was asked to lecture or write on it, but he could not, and he felt deeply his inability to be of use at such a time. He followed the war closely and was filled with pride and admiration at the way in which the British held their own against overwhelming masses of the choicest German troops. In the autumn he went to Westgate-on-Sea, and there he died on 23rd October in his 81st year. His body was cremated and buried at Woking.

The writer cannot end this notice without saying how much he is indebted to Miss Margaret Hale. At her request F.M. Sir Evelyn Wood has written an appreciation of his old friend.

E. M. LLOYD,
Colonel.

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AN APPRECIATION OF THE LATE SIR LONSDALE HALE.

When I joined the Staff College in February, 1863, Lonsdale Hale held an appointment in the Royal Military College, Sandhurst, distant about half a mile, and our acquaintance then begun ripened into a friendship which deepened yearly, and was maintained without a single jar until his death last autumn.

My friend was at that time, the beginning of our acquaintance, known as a very popular, effective teacher. His way of explaining difficulties made even the slowest-minded future officer realize that he was studying under a sympathetic and lucid instructor.

He was known on a hot summer's afternoon, when lecturing to a class of cadets, all of whom had been employed during the forenoon in outdoor work, and after a hearty luncheon, washed down by a glass of beer, were resting their heads on their desk, to arrest the attention of the lads by the emphatic remark "I address my observation to the *one* intelligent cadet I see in front of me," which had the effect of bringing every head briskly up with an air of attention.

I was employed at Aldershot regimentally, or on the Staff, from 1866 to 1873, and again in 1874, when Major Hale went to Chatham, and thus enjoyed for many years great opportunities of appreciating my friend's matchless power of imparting information.

In 1879 I was serving in the north of Zululand, while Hale was on the Staff of the Lines of Communication in Natal, and so only heard of the good work that he was then doing, which was fully appreciated by General Sir Garnet Wolseley.

Many years later Hale became admittedly the best-informed student of all tactical details of the Franco-Prussian War, 1870–1, and for many years personally conducted the senior branch of Staff College students over the more important battlefields in Alsace-Lorraine.

In 1889 he was accompanied to those battlefields by the then Adjutant-General of the Army, Viscount Wolseley, several distinguished officers of the Headquarters Staff, and myself, and we all appreciated highly his consummate mastery of all phases of the battles on which he instructed us.

Our closest intercourse however was during the period of my command at Aldershot, January, 1889—October, 1893. I was interested, and occupied in working out tactical lessons for all ranks in the command. My friend attended all the operations at and around Aldershot, and on the Berkshire Downs, and by my special invitation was present at the Conferences held at the conclusion of each day's work. Later Hale and I discussed with perfect freedom

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the decisions I had given occasionally on the field, and in some cases in printed memoranda issued after all the verbal and written reports had been considered. Hale and I sometimes disagreed, and in private he never hesitated to question the soundness of my decision if he saw occasion, but such difference of opinion never clouded for a moment my affection for him, and my sincere respect for his military genius, and his deep study of our profession.

Hale's booklet, *What to Observe, and How to Report It*, was when he published it a very long way in advance of our official textbooks. His *People's War*, 1870–71, published in 1904, is one of the most illuminating studies that I have ever read.

EVELYN WOOD,
F.M.

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REVIEW.

PAGES D'HISTOIRE, 1914.

(Librairie Militaire Berger-Levrault, Paris : 5, Rue des Beaux-Arts).

A NEW Europe is in the making and we are passing through perhaps the most important epoch in the whole history of the world since the Creation. In order to preserve a permanent record of the events which are now shaping the future of Europe, in the light that they have appeared to the intelligent observers of the day, the Librairie Militaire Berger-Levrault of Paris has commenced the publication of a series of interesting pamphlets under the general title of *Pages d'Histoire*, 1914, in which are collected together extracts from the official documents published by the various Governments, as well as the important portions of leading and other articles relating to the war which have appeared in the leading newspapers printed at the principal centres of the world. The first nine numbers of this series have already been issued to the public, and the tenth is now in the press. The publishers are issuing an Edition de Luxe of this series, as well as an edition on ordinary paper; the former is printed on Japanese paper, a uniform charge of 10 francs being made for each pamphlet, whilst the prices charged for the ordinary edition vary from 40 centimes to 1 franc per pamphlet.

The first number of the series, entitled *Le Guet-Apens*, deals with the Austro-Prussian complot which has embroiled the greater part of Europe in the most stupendous military conflict of all time. The narrative commences with a very brief review of the exceedingly disturbed internal political situations in Great Britain, Russia, and France in June last; situations which it would appear were thought by Germany to offer a propitious opportunity for bringing Russia and France to heel in connection with the Prussian chase after World Power. This number also contains an extract consisting of the more important portions of the Austrian ultimatum to Serbia. The short extracts from the leading European newspapers which complete the contents of this number show clearly enough the intense anxiety caused throughout the Continent by Austria's action.

The second number of the series deals with the diplomatic tension which prevailed between the 25th and 31st July last. An outline of the reply made by Serbia on the 26th July to the Austrian ultimatum appears in this number, and a brief reference is made to the feverish excitement which followed in Berlin on the reception of the news that Serbia had refused to accept the conditions of the Austrian ultimatum in their entirety. The situation in Austria following on the rupture of diplomatic relations with Serbia, and the violent enthusiasm caused in

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Vienna when this fact was publicly announced are also touched upon, as well as the attempts at mediation made by Great Britain, France, and Russia to avert the impending war. This number concludes with the text of the German ultimatum to Russia and the consequential measures taken in France.

The third number opens with the text of the proclamation to the French nation issued by the President of the French Republic announcing that the necessary steps had been taken to mobilize the French Army. This number also contains extracts from the French Law which deals with the procedure to be adopted in connection with a declaration of a "state of siege" in the country. Brief references are published relating to the violations of the French frontier and the occupation of the Grand Duchy of Luxemburg by German troops. The text of the protest of the State Minister of the Grand Duchy to the French Premier against the step taken by Germany in invading Luxemburg is published in extenso, as well as are the terms of the Treaty of London, signed in May, 1867, by which the neutrality of the Grand Duchy was guaranteed. The text of the German ultimatum of the 2nd August last addressed to Belgium and the latter's reply thereto dated the following day are also given in full. This number further deals with the attitude taken up by Great Britain in consequence of Germany's action, and an extract from the statement made by the British Foreign Minister in the House of Commons on the 4th August is also published. The text of the Imperial Rescript published by the German Emperor to his people on the 4th August is contained in this number which concludes with extracts from French newspapers dealing with the military situation during the early days of August.

The fourth number is devoted almost exclusively to the proceedings in the French Parliament on the 4th August; an extract from an article relating to this debate published in the *Figaro* of the 5th August being also reproduced.

The fifth number of the series, entitled *En Guerre*, deals with the events of the three days from 5th to 7th August, as described (principally) by the *Figaro* and *Le Temps*. An account of the German attack on Liège and of the Belgian defence of this town is contained in this number.

The sixth number contains the text of the official communiqués addressed to the Provincial Civil Authorities in France by the Central Government. These communiqués deal with military events which took place in the different theatres of war between the 5th and 14th August.

The seventh and eighth numbers contain information of a character similar to that dealt with in the preceding number, the seventh number covering the period 15th to 31st August; whilst the eighth deals with the period 1st to 30th September.

The ninth number of the series contains copies of letters which passed between the French Minister of War and the French Premier relating to the publication of an official newspaper under the style and title of *Bulletin Militaire des Armées de la République* under the patronage of the latter. This Bulletin is distributed to every officer and soldier of the French Army serving at the Front and is intended to keep him in

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touch with home news and the progress of events. This number contains the text of addresses specially written for and published in the Bulletin; the contributions have been made by leading Frenchmen, numbered among the contributors being the French President, the French Premier, General de La Croix, Vice-Admiral Gervais, Count de Mun, Clemenceau, Deschanel, and Millerand, the newly-appointed Minister of War in the Provisional Government.

The Librairie Militaire Berger-Levrault has also published a small pamphlet entitled *Trois Mois de Guerre*, which gives a brief account of the military operations which took place in the western theatre during the months of August, September and October.

The Librairie Militaire has with commendable promptitude published six further numbers of its *Pages d'Histoire*, 1914, since the review of the first nine numbers was prepared. The tenth number is in continuation of the preceding number of the series, and contains extracts from *Le Bulletin des Armées de la République*, published between the 4th September and 21st October, 1914. This number contains, amongst others, two short articles by Henri Welschinger, one dealing with the protest made in 1871 by Alsace and Lorraine against the surrender of these provinces to Prussia by vanquished France, and another containing a character sketch of the present German Emperor. An article by Charles Bonnefon entitled "Le Culte de Force" is also published. This number further contains copies of the congratulatory messages which passed between the Heads of the Allied States in September last after the successes following the Battle of the Marne. Many of the extracts published in this number are contributions from well-known Frenchmen, and, in consequence, are of considerable interest.

The eleventh number, entitled *A l'Ordre du Jour*, deals with the Mentions in Despatches, and the awards of the Legion of Honour and the "Médaille Militaire" during the period 8th August to 18th September, 1914. This number commences with two reports to the President of the French Republic, one from the French Minister of Foreign Affairs, dated 7th August last, cites the violation of Belgian territory by German troops and the valiant stand made by the Belgians at Liège. The minister recommends in his report the bestowal of the Cross of the Legion of Honour on Liège in order to perpetuate the memory of the gallant deeds of its defenders. The second of these reports is dated 9th August last and therein the French War Minister recommends that the "Médaille Militaire," the highest French military distinction (which can be bestowed even on a general officer), be conferred on H.M. King Albert I. As is well known both these recommendations were immediately given effect to.

This number also contains a copy of the representation made—dated 13th August last—by the French War Minister to President Poincaré urging the adoption of measures to secure a prompt bestowal of the Legion of Honour or the "Médaille Militaire" on those who had earned these distinctions. It appears that by virtue of decrees issued in 1852, a formal Vote of the Chamber of Deputies is necessary in order to confer these decorations on members of the military and naval forces, as they carry other advantages. To meet the present situation a short decree

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was issued on the same date as that on which the War Minister made his representation, and the terms of the same are published in this number.

The copy of another of the documents published in this number is that of a letter dated 5th September, 1914, from Bordeaux, in which the French War Minister draws the attention of the President of the République to the tradition in the French Army which provides for the decoration with the Cross of the Legion of Honour of the colours of a regiment which has captured colours or a standard from the enemy's troops. In his letter the War Minister recommends that this distinction be conferred on the 137th of the Line for the capture of colours from the 28th Prussian Infantry in the engagement which took place on the 27th August between a French Division and a German Corps. This number contains the names of a very large number of officers, non-commissioned officers and men who have been mentioned in despatches and also of those who have been decorated.

The twelfth number is in continuation of the eighth number of the series and contains copies of the official communiqués issued during the month of October, 1914.

The thirteenth and fourteenth numbers are in continuation of the eleventh number of the series; the former contains the names of those mentioned in despatches and decorated between the 19th and 29th September last, whilst the latter contains similar information for the period 2nd to 14th October last.

The fifteenth number, entitled *Les Pourparlers Diplomatiques* (23 Jeuillet—4 Aout), contains a French translation (in extenso) of the White Paper on the European Crisis which was laid on the table of the House of Commons in August last.

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BRIDGE CONSTRUCTED IN THE FIELD.

Bridge 124½ ft. span built by a detachment of —— Field Co., R.E. Clear span of main girders, 65 ft.

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BRIDGE CONSTRUCTED IN THE FIELD TO CARRY MOTOR LORRIES, ETC.

THE bridge was built by a detachment of the —— Field Company, R.E., to take the place of a steel bridge, carrying a road and tramway, that had been destroyed by the Germans. The damage done to the steel bridge can be seen from the accompanying photograph. Communication had been restored at first by a pontoon bridge at another site 200 yards away, but as the approaches were very bad in wet weather and there is a considerable amount of heavy motor traffic a better bridge was needed.

A timber yard containing plenty of deals, 9 in. by 3 in. and under, was close at hand and an engineering shop with a small stock of steel bars and plate was available in the town, so a timber bridge with steel ties was decided on.

At the bridge site the canal runs through a cutting there being a towpath on each side in the cutting. The waterway had to be kept clear and the French Engineers laid down 2·20 metres as the minimum headroom between water level and the bottom of the booms. A little more has actually been given. The total span is 124½ ft. and the bridge is made in five spans, thus leaving a passage along each towpath and avoiding the necessity for big girders in the approach spans. The bridge was designed to take a motor lorry with 13-ft. wheel base, 17,000 lbs. on one axle and 7,000 lbs. on the other.

The cross-bracing in some of the panels is unnecessarily strong, but it was simpler and quicker to use the same section of flat bar steel throughout, as only a few men were available for the steel work. The local shops had not got a large stock of any particular size of bolt, etc., so the bolts and coach-screws in joints vary somewhat in size, and accurate fitting was impossible. 1½-in. camber was given to each girder.

The bridge was within easy shell range of the enemy, but shelling was considered unlikely so the girders were built on the south towpath. German aeroplanes came over once or twice, but the working party took cover and no shelling followed.

Each girder was built lying flat. It was then shifted till one end was near the crib pier and turned up on edge. The weight at the end next the pier was taken by a differential tackle attached to a derrick placed just behind the pier. A strutted "shoe" was fixed about 18 ft. from the other end of the girder to assist in

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keeping the girder upright. This end was then slid out on to a barge on the end of which a small level platform had been prepared for the shoe to rest on. The barge was then moved across the river, the girder pivoting on the shoe which moved easily on the platform. Arrived at the other bank the projecting end of the girder could be easily reached and lifted by another derrick placed behind the north crib pier. Only a small working party was available and delays therefore occurred owing to squads having to be shifted from one tackle to another, but otherwise no difficulty was encountered in moving the girders. Each weighed 2 tons.

Work was actually in progress for 20 days. The working party, except a few men, was withdrawn for one whole day to rebuild the pontoon bridge and on three afternoons besides for other work. The derricks had also to be dismantled in the middle of the work and re-rigged again as the tackles and some of the guys were urgently required for other work. The time-table worked out approximately as follows :—

		Time Occupied from Commencement.
1st day.	Work commenced.	
9th ,,	First girder in position	700 man-hours.
10th ,,	Second ,, ,, ,, ...	1,000 ,,
12th ,,	Third ,, ,, ,, ...	1,300 ,,
13th ,,	Fourth girder in position and roadway part done	1,500 ,,
16th ,,	Bridge ready for foot traffic ..	2,000 ,,
17th ,,	Bridge ready for wheel traffic ..	2,000 ,,
20th ,,	Handrail completed	2,000 ,,

Since it has been built the bridge has been loaded at different times with an 8-ton dray and infantry in fours at a check and has proved quite stiff.

Experience with this bridge suggests that in similar circumstances a bridge having only two girders instead of four and the roadway borne on the lower booms would be preferable as the steel work in the girders would be easier to make and adjust and the time spent in launching girders would be reduced, provided of course that there was tackle available which could deal with the heavier girders. In the present case the differential tackles used could only just manage to lift the 2-ton girders, so heavier girders were out of the question.

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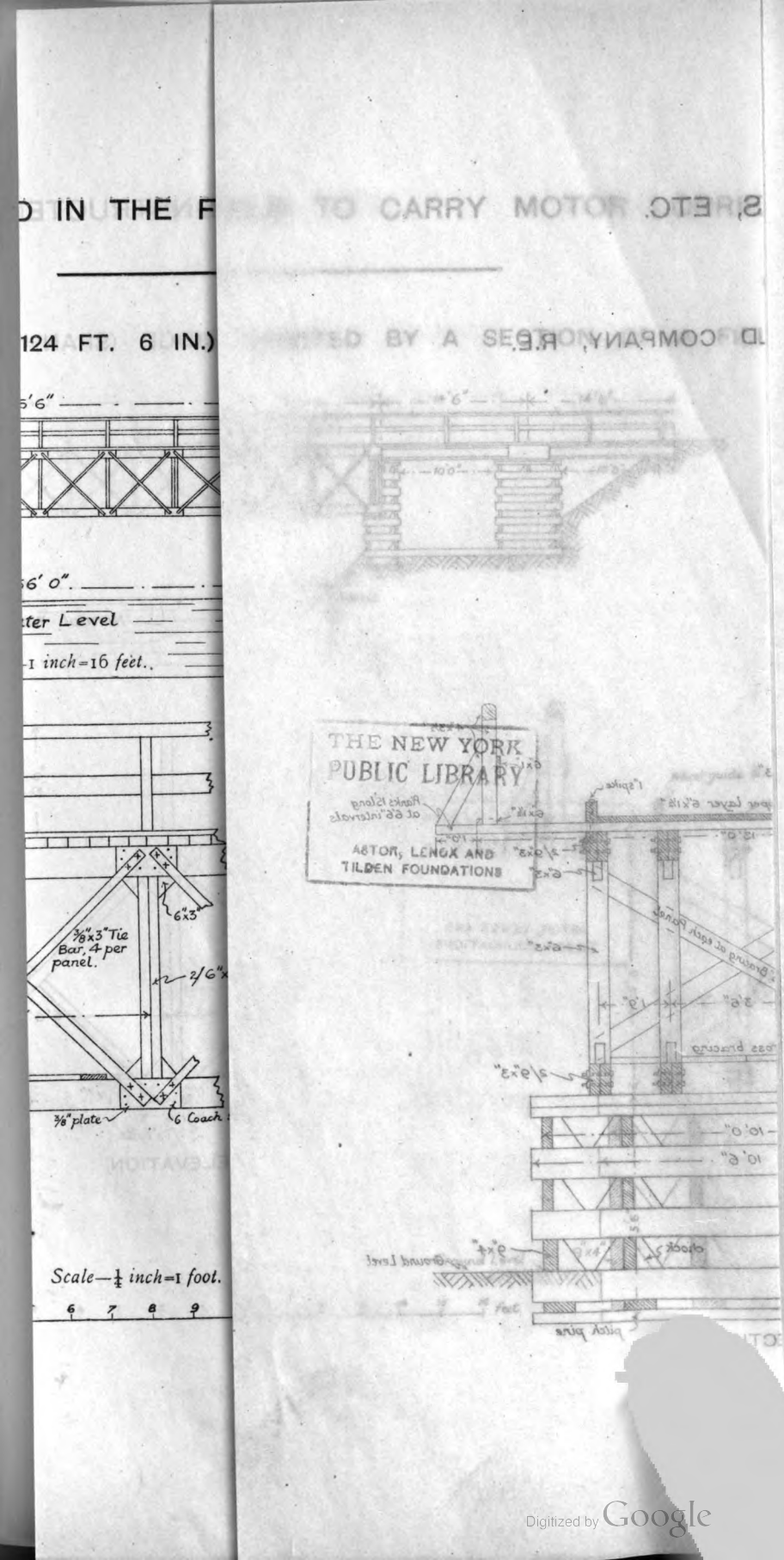

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ENGINEER TRAINING OF THE JAPANESE ARMY.

By the courtesy of the Japanese Military Attaché we have been enabled to reproduce extracts from the translation made by Capt. F. S. G. Piggott, R.E., of the above important work.

(*An instalment appeared in the R.E.J., Feb.*).

Technical Training.

General Rules.

167. The object of technical training is to train officers and men, to inculcate a strict observance of discipline, and to develop a martial spirit, so that all ranks may be able to carry out their technical duties accurately and rapidly, and with mutual co-operation.

168. During technical training individual engineers will often be employed on different work, and it will often happen that the men are divided into squads and parties, scattered over a wide area. Even on these occasions, engineers who have strict discipline and strong spirit can rigorously observe the various regulations, and carry out their work in a reliable manner.

169. In technical training it is important that all ranks are thoroughly trained to complete their work rapidly, so that it is of practical use in accordance with the object in view. Everyone must be warned against embellishing their work unnecessarily, and against wasting time.

170. As regards the details of technical training, the rules of the handbooks concerned will be followed.

171. In technical training, the assembly, dressing, and movements follow the rules laid down for dismounted training, the parade march will not as a rule be employed. When bulky stores are being carried, the intervals and distances between the men may be increased as necessary, and the words of command used in skirmishing drill employed for marching and halting.

Section 1.—Individual Training.

General Principles.

172. The object of individual training is to make each individual man proficient in carrying out his work correctly, as a member of his squad, and so lay the foundation for unit training.

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173. Each branch of fieldworks should always be taught independently; as the work which engineers have to learn, however, is very varied, special efforts must be made to render all ranks proficient and to raise the standard of training, in the most important branches, bearing in mind the demands of war. Paragraphs 183 to 215 of this section are framed on this principle.

174. Individual training in fieldworks will be begun when the men have acquired a fair knowledge of dismounted individual training. At first old soldiers should be made to carry out the work, and the principles inculcated by explanations given by means of the actual materials, or models.

175. The way in which each individual soldier carries out his work has a very close connection with the progress and result of the whole work; for this reason it is essential that instructors should fully explain to each soldier his heavy responsibility, at the same time as they are carefully and thoroughly carrying out the training.

176. In carrying out individual training, it is essential that the men should first grasp the functions of the tools and stores, and learn thoroughly the methods of carrying and using them.

177. A certain amount of latitude should be allowed to the men as regards their positions, attitudes, and methods of handling the tools and stores; work will thus be made easier, and the carrying out of the duty facilitated.

178. The men must keep their ears and eyes especially alert at night, and must be able to work quietly and accurately, even to temporarily improvised signals; for this reason the various kinds of operations must be frequently taught at night, and the men made thoroughly proficient in them.

179. To cause the men to take up their positions for work, the positions will, if necessary, be pointed out, and the following word of command given: "Take Post." The men will then take post as directed, carrying their tools and stores, and stand to attention.

180. To commence work, after the necessary instructions as regards methods to be adopted, etc., have been imported, the following word of command will be given: "Commence Work." The men, if carrying rifles, will place them near by, and immediately begin on the work entrusted to them.

181. To cease work the following word of command will be given: "Cease Work." The men will cease work, and come to attention in their positions, with their tools, or stores, in their hands.

182. When attacked by the enemy while at work, if it is desired to cause the men to take up their rifles which are lying near, the following word of command will be given: "Take Up Arms." The men will cease work, lay down their tools, take up their rifles, and proceed to the positions previously ordered.

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Field Fortification.

183. When training in field fortification, the principal subjects in which the men must be made proficient are digging, the construction of shelter and fire trenches, and of machine-gun emplacements, and the preparation of shelters and obstacles.

184. As regards digging, the men should be exercised in the excavating and heaping of earth, and the grading of slopes; their digging powers must also be thoroughly developed.

185. As regards shelter and fire trenches, the men should excavate them of various sections, and should be especially trained in the formation of the superior slope, the elbow rest, the interior slopes, and other important parts; they should also be practised in the methods of enlarging the trenches.

186. As regards machine-gun emplacements, the men should be trained in constructing them inside fire trenches, and also in isolated positions.

187. As regards shelters, usually some simple type should be selected, and the men trained in its construction inside a fire trench, during the digging of the latter, and also after its completion.

188. As regards obstacles, the principal ones are wire entanglements and abatis. In the case of the former, the men will be practised in the driving of posts, and the stretching and fastening of wire; and of the latter, in the preparation, arrangement, and fixing of the trunks and branches of trees.

189. Training should be carried out at first on simple terrain, and in good soil; the excavation of shelter and fire trenches, and of machine-gun emplacements, and the construction of shelters, should be carried out after the men have become generally proficient in digging.

Bridging.

190. When training in bridging, the principal subjects in which the men must be made proficient are rowing, connecting up, casting anchor, and the use of the trestles, baulks, and chesses of a bridging train.

191. As regards rowing, the men will be practised in the propulsion of pontoons, and wooden boats, by means of oars and poles; the men should be able to propel a boat freely even in a swift current.

192. As regards connecting-up, the men will be practised in the various methods by means of rope, cord, wire, and dogs.

193. As regards casting anchor, the men should be practised in throwing the anchor, and in the handling of the anchor-cable; this training should be carried out after the men have acquired some skill in rowing.

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194. As regards the use of trestles, baulks, and chesses, the men should be practised in their transport and arrangement: the latter should be carried out after the men have acquired a general knowledge of transportation work.

195. Training should be carried out at first in slow currents: also, in the case of those things which can be practised on land, the men should have the main points inculcated there.

Demolitions.

196. When training in demolitions, the men must be made proficient in the preparatory work, and also in the actual carrying out of demolitions.

197. As regards the preparatory work, the men will be practised in the packing of explosives, in the adjustment of the system of ignition and detonation, and in the connection of the latter with the fuze, electric wire, etc.

198. As regards the actual carrying out of demolitions, the men will be practised in the conveyance of the charge, in placing it in position, and in igniting it.

To place the charge in position, the instructor will indicate the place and method, generally on some simple object of wood, iron, concrete, etc., and then cause the men to carry it out.

Ignition, especially ignition by means of safety fuze, must be frequently practised, so that the men may be able to execute it calmly, and with absolute certainty.

199. Delicate handling is necessary in all demolitions; consequently the men should be accustomed to execute them with the greatest care, and be made to understand that when the explosive, and system of ignition, are properly handled, no danger can arise.

200. Training should at first be carried out with dummy explosives, detonators, fuzes, etc.; next the detonators only should be real, and finally a small charge should be used; in this way the main principles will be instilled into the men.

Work during an Assault.

201. When training in work in connection with an assault, the men must be made proficient in the demolition of obstacles, and in the use of appliances employed in an assault, and of hand grenades.

202. As regards the demolition of obstacles, the men will be chiefly practised in the destruction of wire entanglements and abatis, by means of tools, and also of explosives.

203. As regards the use of appliances employed in the assault, the men will be chiefly practised in the handling of leaping poles, ladders, and portable bridges.

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204. When destroying obstacles by means of appliances employed in the assault, it is important that the men should attain proficiency in avoiding being seen and heard by the enemy, and in working as silently and rapidly as possible.

205. When using a hand grenade, the men must choose a suitable spot and attitude, so that they may be able to hurl it at the desired point.

206. Training with hand grenades should be carried out against works with a ditch and flanking support, and provided with other kinds of obstacles.

Sapping.

207. When training in sapping, the men must be made proficient in the construction of shallow, deep, and underground saps.

208. As regards the shallow saps, the men will be practised in their excavation, and in pushing forward the head of the sap, keeping as near the sap-head as possible, and working in a stooping position; they must be made to work so that they can conceal from the enemy's attention as much as possible both the throwing out of the excavated earth, and the advance of the sap-head.

209. As regards the deep and underground saps, the men will be practised in their excavation, and must be made to work in such a way that they will not be discovered by the enemy.

210. Training should be carried out at first as much as possible on flat, open ground, and a skeleton enemy should always be provided.

Mining.

211. When training in mining, the principal subjects in which the men must be made proficient are the construction of galleries and shafts, and the use of the boring machine.

212. As regards mining, the men should be practised in the excavation of as wide branch galleries, and shafts, as possible, and in the fixing of the frames and boards sheeting. The construction of branch galleries will be principally practised, when working straight to the front, and horizontally.

213. When driving a mine, it is of the first importance to preserve the direction, and level, accurately, and to place the frames and sheeting securely; for this reason the men must work with very great care, even as regards the smallest detail, in connection with these points.

214. In using the boring machine, the men must maintain the desired direction accurately, and be able to bore as deeply as possible.

215. Training should usually be carried out in favourable soil.

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SECTION 2.—COMPANY TRAINING.

General Principles.

216. The company is the unit as regards technical work. The object of company training is the maintenance of firm co-operation, so that the company may be able, whatever the circumstances, to carry out its various technical duties with accuracy and dispatch, and in accordance with the wishes of the company commander. When a company is well trained, it will be able, by applying the methods it has already learnt, to carry out work in a suitable way, even though it has not yet been exercised in this particular work.

217. In carrying out any work the company is usually divided into detachments, and if necessary special squads and a reserve detachment are told off. A detachment is subdivided into squads, and if necessary a reserve squad is again told off. The squads may be again subdivided into parties, according to requirements.

Detachments are commanded by officers, and squads by N.C.O's. When there is a shortage in these ranks, the commander of a detachment may be the special sergeant-major or a senior N.C.O., and the commander of a squad may be a superior soldier. For a party, a commander is not usually detailed.

According to the situation, when there is no necessity to divide the company into detachments and squads, the normal organization of sections and groups will hold.

218. In order to prepare for company training, every part of the work will be taught by squads or detachments, in accordance with the regulations laid down in this section.

219. The company commander, in order to direct his company, makes use of orders, or words of command.

220. When beginning work, the company is usually assembled in one place and makes all preparations; this place must be chosen as near as possible to the working area, covered from the view and fire of the enemy, and at a spot convenient for the unloading and distribution of tools and stores from first-line transport. First-line transport, however, may, according to the circumstances, be located at a spot separated from the company's place of assembly.

221. On arrival at the place of assembly, accoutrements and equipment will usually be discarded, and, should the situation permit, arms also will be laid down; such of the portable entrenching tools as may be required will then be taken, and stores and tools distributed from first-line transport. When the position of the latter is at a distance, however, stores and tools will be distributed there beforehand.

222. The issue and receipt of tools and stores from the first-line transport will usually be made to each detachment and squad in rotation.

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223. To move the company to the working area to start work, the whole company may be moved simultaneously, or by detachments or squads, according to circumstances.

224. When it is necessary to arrange for protection by the unit itself, during any work, patrols should be sent out, or look-out men posted, in the direction from which danger threatens.

The Duties of Officers, N.C.O.'s and Men.

225. When about to carry out any work, the company commander, with such officers and orderlies as he may require, should go forward and carry out any reconnaissance necessary. On these occasions the command of the company will usually be delegated to a section commander, who will be given instructions as to the place of assembly, direction of march, etc.

226. In carrying out a reconnaissance the company commander should employ the officers he has with him, in addition to working himself; for this reason he must clearly point out to these officers the object of the reconnaissance, their duties, if necessary any special points to which they should pay special attention, and the time and place at which he will receive reports.

227. The company commander, basing his plans on the result of the reconnaissance, will determine the type and extent of the work to be carried out, the order in which it is to be begun, the *personnel* required, the time allowed, and the distribution of tools and stores.

228. The company commander will consider the convenience of control, and the difficulty of the work, based upon his scheme; when the whole company is carrying out practically identical work, he will divide up the area in his charge, and split up the company into several parts; when every one is carrying out different work, he will usually organize detachments to meet with the several requirements of each different type of work.

When identical work is carried out continuously for a long time, the maintenance of the working power of the company should be chiefly considered, and the company organized into several detachments, to relieve one another.

During the course of the work, when there is anything requiring special technical knowledge, men with these qualifications should be collected, and organized into a special squad.

229. The company commander should issue his orders at the place of assembly, in the working area, or, at times, on the line of march; having told off the company, allotted tasks, distributed tools and stores, and, if necessary, pointed out any important points in connection with the actual carrying out of the work, he will cause the men to begin work.

When the company commander has told off the company, the special sergeant-major, the company-sergeant-major, the quarter-

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master-sergeants, and buglers will remain with the company commander. The special sergeant-major will, according to circumstances, be detailed for the distribution of tools and stores, and the buglers will be attached to detachments as required.

230. The company commander should post himself in the most convenient place for directing the whole of the work, and endeavour to complete it rapidly and accurately.

He will report to the superior commander at suitable times the progress of the work, and, if necessary, the condition of the enemy; he will also inform the commanders of any other units concerned, and it is essential that he should notify the detachment commanders of his own unit as to the enemy's condition. Commanders of detachments and squads should follow the same procedure.

231. When continuing work for a long time, the company commander, if the situation permits, must stop work at convenient times, assemble the whole company, either together, or by detachments, give them the proper amount of rest, and take steps to restore their *morale* and strength.

232. It often happens that orders from the superior commander do not arrive at the proper time, consequently the company commander must be experienced in dealing with things on his own initiative, in accordance with the situation.

233. Detachment commanders will carry out their work accurately, in accordance with the company commander's orders, and are responsible to the latter for its progress, and result.

A detachment commander will, if necessary, subdivide his detachment into squads, assigning to these their duties, detailing them to their posts, and giving them the order to begin work; he should supervise the actions of all ranks, from squad commanders, downwards.

234. A squad commander will, if necessary, subdivide his squad into parties, he will set the men to work, and see that they follow the regulations for the particular work upon which they are employed, and that they use their tools and stores properly; if he should specially notice the necessity, he will himself join in the work.

235. Whenever difficulties are encountered, officers and N.C.O.'s must still further redouble their efforts, and always stimulate and stir up the spirits of their men; especially when they are engaged in work upon which the final issue of an engagement depends, they must bring to bear all their strength of mind and body, take a leading part themselves, and exert themselves to the utmost of their power to achieve the object of the work in hand.

236. During the progress of any work, the transmission of orders, messages, and reports must be extremely accurate and rapid, consequently it is essential that officers and N.C.O.'s in particular

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should consider the various methods of transmission and their efficiency.

237. Work may be carried out after a long march, after excessive exertion, and when suffering from want of food and rest; there are also many occasions when the work lasts for several days and nights. The men should therefore be sturdy and calm, with plenty of self-reliance and patience, so that they can perform their tasks quietly and coolly even in the most dangerous and difficult conditions.

238. When a soldier is wounded, and unable to continue work, or loses the unit to which he is attached, he should act in accordance with the principles of paragraphs 117 and 118.*

Field Fortification.

239. During training in field fortification, the preparation of the various kinds of works used in the attack and in the defence must be mastered.

240. The principal arrangements for defensive fortification are the preparation of infantry, artillery, and machine-gun positions, clearing the field of fire, and the construction of obstacles. Work is generally carried out in this order; according to the situation, however, there are times when it is necessary to clear the field of fire first, before the construction of cover.

241. In the construction of infantry, artillery, and machine-gun positions, the company commander should select a defence line, which will, in the first place, enable him to develop fire effect, which will not be observed by the enemy, and which conforms to the general configuration of the ground.

242. In an infantry position, fire trenches, and if necessary, shelter, and communication, trenches will be constructed.

Fire trenches should usually be constructed for firing standing; therefore, if a simple cover trench has been constructed when time presses, it must be at once improved as soon as the situation permits. When there is plenty of time available, however, and also in the case of *points d'appui* of the position, enlarged fire trenches will usually be constructed in the first place.

* 117. Men wounded, and unable to continue in action, will hand over their ammunition to their comrades, and, waiting for the order from their commander, slowly withdraw from the firing line.

118. A soldier may not leave the unit to which he is attached without permission; to leave the firing line independently, when without any special duty, or when slightly wounded and still able to continue fighting, or to tend or carry away the wounded during an action without orders, is cowardly conduct and harmful to the duty of a soldier.

Should a soldier lose the position of the unit to which he is attached, he should at once join a unit fighting in the neighbourhood, report to its officer, and obey his orders; when the action is over, however, he must immediately return to his own unit.

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Cover trenches will, according to circumstances, be close to the fire trenches, so that the troops in rear may be able to reinforce the firing line without losing a moment; communication trenches will keep such a direction that they can avoid the enemy's enfilade fire. Both types will be constructed so as to utilize as much as possible local ground objects.

In both fire and cover trenches, a sufficient number of simple traverses, shelters, and if necessary parados, should be constructed, to limit as far as possible the effect of splinters and bullets from the enemy's shells; their number and arrangement must be decided after considering the direction of the enemy's fire, and the configuration of the ground.

243. The trace of a fire trench is the basis of all preparations for fortification, and should therefore be the first thing undertaken; it is usually sufficient to indicate the crest line of the work by some simple method. In the case of a work of large and powerful section, the position should, if possible be surveyed beforehand, and a sketch made, the trace and profile must then be marked out where necessary, in accordance with the sketch.

244. In the preparation of an artillery position, cover for the gunners, observation posts, epaulments for the guns, and, if necessary, shelters for the officers and N.C.O.'s, should be constructed, and arrangements should be made for intercommunication between the epaulments.

245. In the preparation of a machine-gun position, cover for the gun platforms, for the guns, for the ammunition, and for the gunners, should be provided; if possible overhead cover should be constructed also, according to the site of the position.

246. In infantry, artillery, and particularly machine-gun positions, the works should be as much as possible covered, and also disguised. When arranging dummy trenches, special care must be given to their siting and method of construction.

247. In the case of positions which are to be defended for several days, the fire trenches in particular should have a large and powerful section, and there are times when cover for the ammunition carts should be provided for the artillery. If necessary, arrangements will also be made for night firing, and for observation; for communication posts and for dressing-stations, for depôts for ammunition and hand grenades, and for drainage and other accessories.

248. In clearing the field of fire, the company commander should determine the area and extent it is to be cleared, so that as extensive a field of fire as possible is obtained, and at the same time our position not exposed to the enemy, nor our fire obstructed. Work should usually be begun near the firing line, and gradually extended in the direction of the enemy.

Whilst clearing the field of fire, ranges should be taken to

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important points; these points, will, if necessary, be marked. A base line, by means of which other ranges may subsequently be taken if required, should be laid down inside the work.

249. In constructing obstacles, the company commander should select places where the enemy might easily approach our position, where it would be difficult for them to detect the obstacles, and where it would be possible to protect adequately the obstacles against schemes for their destruction. They may be suitably sited about 30 metres in front of the firing line, so that even at night, and in fog, they may be fully protected.

The company commander should select obstacles as easy to construct as possible, and of the greatest effect, bearing in mind the configuration of the ground, and the stores available. Wire entanglements and abatis usually meet these requirements, and are, in consequence, often used; but ditches, inundations, stakes, pits, fougasses, etc., may be utilized according to circumstances.

250. In the preparation of infantry, artillery, and machine-gun positions, and in clearing the field of fire, work should be divided according to the particular area; in the construction of obstacles, the tasks allotted to each detachment should be settled according to the class of work.

251. In offensive fortification, the most important arrangements are the construction of the attack position, and the communication trenches.

252. In an attack position, the enlarged type of fire trench will, as a rule, be first constructed; this should subsequently be further enlarged so as to facilitate the defence of the position, the assembly of the troops, and communication; traverses and shelters should be constructed if necessary, and obstacles prepared at important points. In the case of the position from which it is intended to launch the actual assault, in particular, the width of the trench should be enlarged so as to be suitable for the assembly of the assaulting column; places for the tools and stores used in the assault, and steps for egress, should be constructed, and, if necessary, further provision of cover made.

253. Communication trenches should be originally constructed so as to be suitable for the passage of infantry in single file, at least; they should subsequently be enlarged in accordance with the class of troops by which they will be used.

254. A proportion of artillery is sometimes specially placed inside an attack position; a position for them, with ammunition recesses, traverses, shelters, etc., must therefore be constructed, and communication trenches enlarged so as to admit of the entry of the guns.

255. In constructing an attack position, and its communication trenches, the company commander will reconnoitre beforehand the

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line of the work, the approaches to it, and the halting places. The line of the work should be traced, as far as possible, at dusk, and, if necessary, the entrances marked.

256. The company commander should tell off the company, distribute tools at the tool depôt, and proceed to the halting place; if necessary he should there issue further detailed instructions, and, when opportunity offers, lead his men into the working area.

257. The distribution of the company along the trace of a work must be carried out quietly and accurately. The company commander, therefore, bearing in mind the situation, and, in particular, the configuration of the ground and the degree of darkness, should advance his men to the trace in column to a flank, either as a whole company or by successive detachments; each file should then be posted in succession, or the company disposed as in extended order.

258. When a company begins to prepare an attack position, some cover by which to oppose a sortie on the part of the enemy should first be constructed, and subsequently an enlarged fire trench should be prepared. When this has been completed, the company will, as a rule, be relieved.

259. The relieving company should continue the enlargement of the trenches, and, as required, construct traverses, shelter and other accessories, either concurrently, or after completing the trenches; the necessary obstacles should also be prepared.

260. When it is wished to prepare an attack position in small portions at a time, unknown to the enemy, the company commander should employ several small working parties; these will each construct a portion of the work, making use of, as far as possible, ground objects in the vicinity, and also works abandoned by the enemy, craters formed by high-explosive shells, etc.: the portions so constructed should subsequently be joined up.

261. Communication trenches should, if possible, be constructed at the same time as the attack position, and be subsequently enlarged by the relieving company.

Bridging.

262. During training in bridging, the construction of bridges by means of column, and improvised, stores, must be mastered, as well as the various arrangements for the passage of a river.

263. Bridging with column stores will usually be carried out when it is necessary to complete the bridge quickly, and especially in the presence of the enemy; it is the usual rule to bridge with improvised stores when there is no urgency in the situation. Auxiliary means of crossing a river will usually be adopted when the bridging stores available are insufficient, or when the number of men, horses, and vehicles to be conveyed across is small.

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264. In constructing a bridge it is usual to build each bay in succession from the near bank; when the river is wide, however, or it is necessary to build the bridge quickly, it should be constructed from both banks simultaneously, should the situation permit. In the case of an exceptionally large river, it is advisable to establish several strong fixed points in the stream, and to build from these as starting points.

265. Actual bridging should usually be begun after all preparations have been finished; this is especially the case when in the presence of the enemy. The preparation of the entrance, and especially of the exit, may however be undertaken, even while bridging work is in progress; there are occasions, also, when work may be begun on the bridge although the preparations are not all completed, should there be sufficient men to carry out the preparations, and actual bridging, simultaneously.

266. The company commander should settle upon his plan for bridging, after making a reconnaissance of the site, and carefully surveying the river; he should first decide where the bridging column is to form up, and if necessary prepare an approach to this place.

267. The company commander will organize a certain number of detachments to arrange the bridging stores, to carry out the actual bridging, and, if necessary, to prepare the approaches on either side.

When improvised stores are used, he will, in addition to the above, detail the necessary detachments to collect and transport *matériel*, and he should form special squads for carpenter's, and, if necessary, smith's, work, in order to prepare the material for the piers and superstructure.

268. The company commander will indicate to each detachment commander the position of the bridge, and, if necessary, the measures to be taken to conceal operations from the enemy. To the commander of the detachment responsible for arranging the stores, he will show where the bridging column is to form up, where the stores are to be placed, and how they are to be issued and transported; to the commander of the detachment responsible for the actual bridging, he will show the axis of the bridge, the line of the anchors, the type of piers, and the method of anchoring, etc.; to the commander of the detachment responsible for the construction of the approaches, he will show the base line of the road; after which, work will be begun.

When improvised material is used, he will, in addition to the above, indicate how the material is to be collected and transported, and how the piers and superstructure are to be constructed, and incorporated in the bridge.

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269. The detachment responsible for arranging the stores will first receive them from the bridging column, and then bring them to the store depôt; they should lay out the stores in an orderly manner, so as to avoid confusion and delay when the bridge is about to be constructed.

270. The detachment responsible for the construction of the bridge will first clearly mark out the axis of the bridge, and the line of the anchors; the shore end will then be constructed, and the pontoon piers, and anchor boats, etc., prepared. During work on the bridge, the axis, in particular, must be carefully maintained, the anchors securely fixed, and the superstructure firmly connected.

271. The detachment responsible for the preparation of the approach to, and exit from, the bridge, must specially bear in mind the passage of artillery, and make the approach and exit of suitable gradient and curve, so that the bridge may not suffer from violent shocks.

272. In order to transport troops across a river by auxiliary means, the following methods should be adopted, according to the situation, and, in particular, the condition of the river, and the quantity of bridging materials available, etc., viz.: flying-bridge, (*keiryū-watashi*, Fr. *pont-volant*), ferry-boat, (*kwakkō-watashi*, Fr. *bac à traille*), hauling a boat along a cable stretched from bank to bank, (*kurizuna-watashi*, Fr. *va et vient*), or rowing, (*kogi-watashi*, Fr. *passage à la rame*). The last-mentioned method is convenient for effecting the passage of large numbers of men simultaneously.

273. To pass troops over a river by rowing boats, the company commander should reconnoitre the condition of the river, and the configuration of both banks; he should bear in mind the number of boats available, and the time required for a boat to cross and return, and fix upon as many places of embarkation and landing as possible; he should decide on the intervals between these, in accordance with the speed of the current, and the breadth of the river; and, so that he can control the crossing with certainty, he will tell off to several of these places one detachment, and allot the necessary boats and rowers. In order to prevent confusion, he will indicate the general course required to be taken across the river by each detachment going and returning; if necessary he will erect marks for this purpose.

He should also inform the officer commanding the troops who are being sent across the river regarding the number of parties to be taken across at the points of crossing of each detachment, their place of assembly, the method of embarkation, and also any points in connection with the crossing; and he will see that his instructions are carried out accurately.

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Communications.

274. When training in communication work, the construction and repair of roads, the preparation of observation posts, and the cutting (demolition) of roads, railways, and telegraphs, must be mastered.

275. When making a road during field operations, it is generally necessary to complete it in a short space of time; it is limited, therefore, to simple work, and is rapidly constructed, making use of the natural surface of the ground as much as possible. Occasionally there are times when it is sufficient to construct some cover from view and fire, or to erect some marks to show the way. When roads have to be used for a considerable time, however, they must be strongly constructed, and full provision made for drainage. The above principles apply also to the repair of a road.

276. In constructing a road, the company commander should select the shortest possible distance for the guiding line, bearing in mind the purpose for which the road will be used, the difficulty or otherwise of the work, and, if necessary, the extent to which it should be concealed from the enemy's view. On the other hand, there are occasions when, by using a circuitous route, the work is slight, and the passage of the troops easy. In the case of marshy or soft ground, there are times when it may be better to rely on bridges.

277. In order that the whole length of a road may be completed about the same time, the company commander should divide it into sections for work, and allot detachments to these sections. In the case of a very long road, the sections for work will be so divided that portions of the road may be finished successively.

When it is necessary to construct anything requiring special technical skill, special squads for carpenter's and mason's work, etc., will be formed.

278. In making arrangements for observation, the configuration of the ground should be considered, and places selected where there is an extensive field of view, where all important points can be properly kept under observation, and where it is easy to avoid the enemy's notice.

In order to observe accurately one particular point a long way off, several observation posts must be prepared.

279. In cutting roads, railways, telegraphs, etc., the company commander should, to the best of his power, select places extending over a considerable area, and where repairs and deviations are as difficult to carry out as possible.

In the destruction of roads or railways, most advantage is gained if it is carried out at bridges and tunnels. In the case of roads, in addition to the above, roads of steep gradient at the side of a hill, raised and sunken roads, marshy ground, causeways, etc., should

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be chosen; and in the case of railways, curves, embankments, cuttings, and stations, should be selected.

In interrupting telegraphs and telephones, it is best to cut the poles, and wires, at a bend in the line; it is particularly effective to cut underground wires, and destroy signal stations.

280. In destroying roads, railways, telegraphs, etc., the company commander will select the method to be adopted, after considering the situation, and, in particular, the urgency or otherwise of the occasion, and the stores available.

281. In the destruction of roads, railways, etc., the company commander should divide the whole length into sections, and allot detachments to each section.

282. In connection with the cutting of roads, railways, and telegraphs, the instructions given in *Field Service Regulations* should be followed.

Work during an Assault.

283. During training in the conduct of work during an assault, the destruction of obstacles and of the arrangements for flanking protection, and the provision of means to cross the ditch, so as to open a path for the assault, must be mastered. It is also very important that officers and N.C.O.'s should be trained in reconnaissance work in connection with the above.

284. Among the various kinds of obstacles, wire entanglements are destroyed by means of tools or explosives; sometimes they may be crossed by covering them over with some suitable material.

The counterscarp, and the arrangements for flanking protection are blown up by means of underground mines; in the case of those of simple construction, however, they may be demolished by means of explosives placed against the surface. In order to render flanking protection temporarily useless, material emitting a dense smoke when lighted may be thrown into the loopholes to hinder the enemy's actions.

In order to cross the ditch, leaping poles, ladders, portable bridges, etc., are usually used.

285. The route for an assaulting party must be made wide, so that they may be able to cross on as broad a front as possible. The minimum width must not be less than 3 metres.

286. The company commander should employ several patrols in order to reconnoitre the state of the obstacles, and of the arrangements for flanking protection, and give to each as simple a mission as possible. When sending them out, advantage should be taken of fog, darkness, or favourable opportunities during the artillery bombardment; each patrol should be made to submit a scheme, based on a careful reconnaissance, showing the places selected, and methods proposed, for demolition, or for crossing.

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A patrol should consist of a few men under an officer; but according to the situation there are occasions when a single individual is employed.

287. The company commander, as a result of the reconnaissance, should be quite clear as regards the state of the obstacles, and the arrangements for flanking protection. Bearing in mind the condition of the enemy, the object to be attained, and the degree of light, he should determine the number of routes to be prepared for the assaulting parties, their positions, the time, and the method to be adopted.

288. To prepare a route for an assaulting part, the company commander should organize a certain number of detachments, corresponding with the number of assaulting columns; the position, extent, and method of construction of these routes will be indicated to the detachment commanders, all preparations should be fully made and work begun immediately the moment for doing so arrives.

289. The detachment commanders should organize a certain number of squads, corresponding with the number of lines of obstacles, so that there is one squad to each line; the strength of each squad should not be more than the minimum necessary.

290. A detachment commander should push on ahead, leading the squad detailed for work on the nearest obstacles; when the first line of obstacles has been destroyed, he should advance the second squad, and move it to the front in succession.

291. When intending to clear a route for an assaulting party unknown to the enemy, and being discovered by them half-way, the men must never falter, but boldly continue advancing, even though subjected to a deadly fire. In addition to this, officers and N.C.O.'s should take the lead, and stimulating the men by their intrepid conduct, use their utmost endeavours to accomplish the task.

292. Each squad, when it has attained its object, should immediately report the fact to the detachment commander; the squad remains on the spot, completing its work, and only retire on the order of the detachment commander.

293. When the actual assault is not carried out immediately on the completion of the routes for the assaulting parties, the detachment commander should keep some of his men near the already-completed routes until the arrival of the infantry look-out men, so as to prevent the enemy carrying out any repairs. When it is intended to make the assault by night, the routes for the assault must be clearly marked, but in such a way that they cannot be detected by the enemy.

294. The tools and stores to be used in the assault will be prepared with the greatest care, in accordance with the state of the

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obstacles; they will be arranged beforehand inside the position from which the assault is to be launched, so as not to attract the enemy's attention.

Sapping.

295. During training in sapping, the construction of approaches and attack positions, by means of the various types of saps, and also the work in connection with the close approach to the enemy's works, are the principal subjects which must be mastered.

296. In the construction of approaches, various types of saps are used, according to the situation. Usually it is advantageous to depend upon the shallow sap as much as possible, as its rate of advance is rapid; but when in very close proximity to the enemy, as it is difficult to arrange for shelter in the trench, and as the general progress of the attack is very slow, it is often better to depend rather upon the deep sap; when it is necessary to avoid the enemy's observation, it is specially necessary to use this type. When the situation does not allow this kind of work, the tunnel sap is used if the condition of the soil is suitable.

In the construction of an attack position, the shallow sap is generally used.

When excavation is difficult, or it is intended to work secretly, unknown to the enemy, taking advantage of darkness, fog, etc., it is advantageous to use sandbags as a method of forming cover.

297. In the construction of approaches and attack positions, the company commander will take into consideration the direction of the enemy's fire, the configuration of the ground, nature of the soil, etc., and decide the direction of the sap, its type, and the point from which it breaks out, so that it may reach the objective point quickly and safely.

298. The company commander will usually divide the company into three detachments; these will relieve each other in succession every six or eight hours, and the work will thus proceed continuously day and night.

299. The company commander is solely responsible for the rapid progress of the work. He must, therefore, besides giving constant attention to the situation, and carrying out suitable measures according to circumstances, invariably make use of all local ground objects, and also of works evacuated by the enemy, and craters made by high explosive shells, etc., when these exist; he must strive whole-heartedly for a rapid advance, and there must on no account be any check, even for a moment, for the sake of arrangements to enlarge the trenches in rear, or for firing, etc.

300. A detachment commander will organize several squads, in accordance with the number of approaches for which the company is responsible; each squad is divided into two parties, which relieve

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one another. He should also form special squads for enlarging the trenches, and for preparing for fire, and shelter.

When breaking out saps from one or both flanks of the head of an approach, for the purpose of constructing an attack position, the required number of squads will be formed accordingly.

301. The commander of a detachment, should he notice a good opportunity for taking suitable measures to expedite the progress of the work, must immediately seize it without hesitation; he is also responsible for maintaining the correct direction and width of the saps.

302. A squad commander will make every effort to advance the excavating work; he should constantly inspect the direction and width of the sap, and take care that these are always correctly maintained.

303. Even though the enemy should make a sortie while work is in progress, the men should calmly continue working; on these occasions the troops in the nearest attack positions will cover the working parties with their fire.

304. When the head of the approach has reached a point in its advance where it is insufficiently covered from the attack position, the company commander should prepare near here, on one or both flanks of the approach, special trenches for fire; or he should utilize bends in the approach for this purpose.

305. The new detachment should reach the area of work before the hour for relief, and make all preparations for work; the old detachment should wait till all preparations are complete, and then hand over and withdraw to the rear. During this time there must not be even a momentary break in the work. The commander of the old detachment should enter on his working plan the work executed, and in his sap diary the dispositions of the enemy and any other important points, and notify them to the commander of the new detachment.

306. When the defender constructs saps, the above rules should be generally followed. The sap should usually break out from some point in the fire trenches outside the fort, or from some local ground object there.

Mining.

307. During training in mining, the construction of a system of mines, the destruction of the enemy's mines, the occupation of craters, approaching the enemy underground, and also the ways to hinder these operations, must be mastered. It is also very important that officers and N.C.O.'s should be proficient in the reconnaissance of the enemy's dispositions.

308. An offensive system of mines will usually be formed by branch galleries, at an average interval of from 10 to 15 metres,

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in order to expedite the work. Moreover, in order specially to increase the effect of the explosion towards the enemy's direction, or to protect the mines from being surrounded by the enemy, there are times when bore-holes will be used.

In the case of a defensive system of mines, in order to facilitate boring operations, and in order to afford good ventilation, the main gallery will usually be constructed beforehand. When in the vicinity of the enemy, in order to prepare the charge chambers in the desired positions, bore-holes or branch galleries will be pushed out from the main gallery.

Shafts will be sunk in order to facilitate the construction of galleries, or for the purpose of preparing a charge chamber at the bottom of the shaft.

309. In the construction of an offensive system of mines, the company commander will take into consideration the position of the defensive mines, the configuration of the ground, and the nature of the soil, and will determine the type of each mine, the intervals between them, the position of the entrances, their direction and slope, and the positions for charge chambers, so that the objective may be quickly reached and destroyed; he will also prepare a plan of the system.

310. The company commander will usually divide the company into three detachments, which will relieve each other in succession every six or eight hours. He will show to each detachment commander his prearranged task, by means of the plan of the system, and he will carry on the work continuously day and night. He will also detail special squads as required for the care and supply of tools and stores, and for taking measurements.

311. The company commander, in order to push forward each mine equally, must, in particular, keep control of the mining work, and ensure that the advance is simultaneous and rapid. He should also keep a constant watch upon the enemy's dispositions, and alter the type, direction, and slope of the mines, as may be necessary.

312. A detachment commander will organize a certain number of squads, according to the number of mines allotted to the company; he will divide each squad into two parties, which relieve one another.

313. A detachment commander will settle important details, based on the company commander's instructions; he is specially responsible for the correct maintenance of the direction and slope of each mine, and for the uniform and rapid progress of the system. He should, also, from time to time, observe the enemy's dispositions, and immediately report the result to the company commander.

314. The squad commanders will check very carefully the direction and slope of the mines, and the correct fitting of the frames

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and sheeting; they will also observe the enemy's dispositions in accordance with the directions of their detachment commander.

315. As regards the reconnaissance of the enemy's dispositions, the position, type and extent of the hostile works may be judged from a consideration of the configuration of the ground, and the nature of the soil, in the vicinity, and from the degree and kind of sound; but it is specially important not to be deceived by the enemy's false works.

316. When the hour arrives for the relief of a detachment, the detachment commanders will act as described in paragraph 305; the commander of the old detachment will also fill in on the plan of the work, the work done by him, and enter on the mine diary the enemy's dispositions, and other important points; he will notify these to the commander of the new detachment.

317. When the time for the explosion arrives, a charge chamber will be prepared at the head of each mine, and the charge tamped and ignited.

When the situation demands haste, there are occasions when the charge will be merely placed at the head of the mine, and roughly tamped, or not tamped at all, and exploded immediately.

318. The company commander will give orders at a suitable moment to the detachment commanders, for loading, and igniting the charge in the charge chamber.

319. When a detachment commander sees that there is a good opportunity for loading and igniting the charge in the charge chamber, he will immediately report the fact to the company commander; as, however, the opportunities for exploding the charge are only fleeting, he will take action on his own responsibility when the occasion admits of no delay.

320. When it is intended to occupy craters, the company commander will, before the explosion, allot detachments to each crater to carry out the work in connection with their occupation; and he should indicate important points with regard to the preparation for fire from the edge of the craters, and the opening up of communications in rear.

The *personnel* of detachments detailed for work in connection with the occupation of craters will be kept to the minimum strength requisite.

321. A detachment commander will organize a certain number of squads, according to the type of work indicated by the company commander. Immediately after the explosion, he will himself dash into the crater with a few men, examine the traces of the defender's galleries which have been blown up, and see whether there is any danger; having done this he will call up in succession into the crater the other squads and the party for occupation, who then carry on with their prearranged work.

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322. Having occupied a crater, the company commander, in order to connect with neighbouring craters, and drive a new mine, will, if necessary, tell off the company again, and immediately start work.

323. A detachment commander will form a certain number of squads, according to the kind of work; he will take special care that the position of the mouth of the mine is concealed from the enemy, and execute the work rapidly.

324. In the construction of a defensive system of mines, the above instructions will be generally followed.

The defender, judging beforehand the direction of the enemy's advance, will prepare as large a number of bore-holes, or branch galleries as possible, and await the enemy's coming; if necessary the direction of the enemy's advance should be reconnoitred, fresh bore-holes made, or short branch galleries driven; charge chambers should then be prepared at suitable moments, and the charge exploded. The charges for this purpose should be limited to the minimum necessary for the destruction of the enemy's mines.

SECTION 3.—BATTALION TRAINING.

325. The object of battalion training is to use the three companies as a single body, and render them capable of carrying out any large and important work in the division.

326. The battalion commander usually makes use of orders, as opposed to words of command, to control the battalion.

327. The battalion commander will point out the objective to each company, allot to them the duty for which they are each responsible, and see that the work is carried out uniformly.

When the work of each company is interdependent on that of the others, the battalion commander must see that the companies work in co-operation.

328. The battalion commander will, if necessary, arrange for the interchange of the technical tools and stores from regimental transport, according to the nature of the work for which each company is responsible.

329. When it is necessary for the battalion to requisition local material, the battalion commander will usually organize one party, drawn from each company, and make it responsible for the collection, arrangement, and distribution of this material.

330. As regards the command of a battalion, the principles in Part II., in so much as they refer to officers commanding engineers, should be followed, and also the instructions for company commanders included under Company Training, in addition to what is laid down in this section.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF SEBASTOPOL (*continued*).

The Siege from the Middle of February, 1855, *to the Second Week of April.*

Colonel von Todleben saw that to defend the Mamelon the new French "approaches" on his left front must be arrested, and that then he might prevent them from acquiring ground whence their batteries would be able to drive off all Russian ships from the eastern part of the Roadstead.

Having taped down beforehand the lines of a newly-planned Redoubt, he moved out on the night of the 21st February with seven battalions commanded by General Khroustchoff, crossed the channel of the Careenage Ravine, ascended to the heights of Mount Inkerman, and under shelter of darkness laid hands on the chosen site.

The men were kept in a state of readiness to lay down their tools, and to take instant part as combatants whenever the need might occur; but they toiled undisturbed the first night, and when morning broke, it was seen that the cover already obtained by dint of pickaxe and spade, and gabions rapidly filled, was even then solid enough to be good against musketry fire. This work was called the Selinghinsk Redoubt after the name of the regiment that constructed it.

The French did not molest the new work until the early morning of the 24th. They then undertook to assault it with a force of three battalions, supported by two in reserve, and entrusted the command of the troops to General Mayran. The attacking part of the force consisting of one battalion column of Zouaves at each flank, and one of Marines in the centre was under the immediate orders of General Mouet.

When the moon had gone, General Mouet's three battalions

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moved forward, and made good their advance with great spirit, driving in both the line of skirmishers, and the line of company columns which formed the front of the Volhynia Regiment, and apparently forcing back also two out of its three massed battalions. The ships in the Roadstead, and even the Karabel batteries soon began to intervene, but the advance of the French was not checked. The battalion of Zouaves on the right of the assailing force was commanded by Colonel Cler, a daring and brilliant officer much liked by our people. At the head of his Zouaves he turned the flank of the Russians, and pushing forwards so vigorously that before long carried the fighting to ground on the left of the growing redoubt.

To meet the stress of battle brought thither, the unengaged column of the Volhynia Regiment was moved laterally by Khroustchoff from his right to the ground on his left where the Russians were most hotly pressed. Before long the four Volhynia battalions, with some men of the Selinghinsk Regiment intermixed, gathered irregularly in advance of the new redoubt, presenting to their assailants a broad, concave front. General Mouet now received several wounds, and finding himself compelled to give up the command he handed it over to Cler, who was called away from the right in order to receive his new charge.

Cler, however, soon returned to his Zouave battalion, taking with him all the troops that he found on his road, and going in person up to the work knocked over the gabions revetting a part of its counterscarp, crossed its ditch, overthrowing the Russians there gathered, and mounted the parapet. But then he learnt that notwithstanding the darkness, the redoubt and its precincts were swarming with troops, and those of the French who had till then remained alive on the parapet were forced back into the ditch, and were there surrounded by Russians coming from all directions. To the fire of musketry there was added the fire from ships in the Roadstead, and even from the Faubourg Defences. But Colonel Cler stood his ground in the fosse hoping that reinforcements might come. But now General Mayran, becoming convinced that his foremost troops were in danger, caused the retreat to be sounded.

Thereupon, Colonel Cler passed back over the counterscarp, led the men acting with him against the host of Russians who were barring his path, clove a way through their ranks with the bayonet or the musket-stock used as a club, and rejoined the rest of the force which General Mouet had led. The French force thus reunited made good its retreat without being pursued.

General Mayran did not bring into action the troops which formed his reserve. The fight lasted an hour.

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In killed, wounded, and missing the French lost some 270, and the Russians rather more than 400.*

The French did not renew their attack. Convincing themselves that, if captured, the Selinghinsk Redoubt might be swept by so potent a fire of artillery as would make it untenable, they resolved, however unwillingly, that they must needs stand by whilst the enemy, losing no time, completed and armed his new work. And this bold encroachment effected under their eyes was only the beginning of the counter-approaches, with which the Czar's great engineer was minded to try their patience.

Seizing ground that lay towards the left front of the newly-formed work, on the night of the 28th February he began to construct yet another one of a similar kind which was called the Volhynia Redoubt; and he lost no time in rendering it stronger every day.

Although the Allies by this time saw the object at which he was aiming, viz., to attempt the fortification of the Mamelon, they still resolved to abstain from storming the newly-reared works which now formidably obstructed their siege, contenting themselves with promising that so soon as the enemy should try to plant any field-work on the coveted Mamelon, they would carry it at once by assault.

Meanwhile their counsels induced them to await the actual happening of the apprehended contingency, and not undertake to avert it. The question whether the Allies should submit to these aggressions was one of course meriting their joint consideration, and accordingly, a council assembled. It included General Canrobert, Lord Raglan, General Bosquet, General Niel, General Birot, Sir John Burgoyne, Sir George Brown, and General Harry Jones. It lasted several hours without coming to any definite resolve. On the following day the council again met and discussed the general progress of the siege. The difficulties of the attack were a good deal dwelt upon, and were acknowledged to be increasing rather than diminishing.

The importance of endeavouring to take what with normal besiegers has commonly been called the first step, that is to invest the place, or in other words to cut off communication between Sebastopol and the Russian field army was much dwelt upon, whilst General Canrobert declared his opinion to be that, if from any cause Omar Pasha should be unable to act upon the rear or flank of the enemy from Eupatoria, he should be requested to come to the Chersonese with two-thirds of his army. Lord Raglan stated his reasons for not sharing the opinion thus formed by General

* *Todleben*, Vol. II., p. 30.

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Canrobert. The French and English engineers did not come to any agreement, and the adjourned conference sat again on the 6th March.

Then the French making no proposal, Burgoyne submitted a memorandum recommending an attack on the Selinghinsk and Volhynia Redoubts with a view to driving the enemy effectively from that part of the ground.

General Canrobert and the French officers attending him did not consider the reasoning by which Sir John Burgoyne supported his opinion to be well founded; and they at once declared their determination not again to attempt to drive the enemy from his new works. Whilst the Allies were thus vainly deliberating, their adversary was acting with ceaseless vigour.

The Volhynia work was completed in the course of ten days; and the armament which the two new redoubts had received on the 10th of March comprised 22 pieces of cannon.*

To have a strong hold on the Mamelon was the object of besieged and besiegers alike, but it had not up to this time been the chosen scene of their efforts. Lightly held by an outpost of Russian infantry, it had neither been touched by the pickaxe nor assaulted by troops, nor even approached by "approaches"; but by the morning of the 10th March that state of affairs was fast drawing to an end.

Looking towards the north-west on the morning of the 11th March the Allies saw that during the night, their great adversary had been fastening on the Mamelon, and that there, with the rudiments of a work plainly meant to defend it, he had already saddled the Ridge. On the following night, the 11th March, the French opened their first parallel, against the new work, not yet one day old; thus almost repeating the all-involving mistake of the previous autumn, that of "besieging" an embryo.

To enter on a course of "approaches" was to give the enemy time. The Allies before long brought a powerful artillery fire on the growing lunette, but as the French were as yet not minded to undertake an assault they had to bear the torment of seeing or otherwise knowing that every day and night their unwearied adversary was completing his work. He finished it on the 21st March, and by that time had not only armed it with ten 24-pounder guns, but covered it by the fire of twelve other pieces, planted for that purpose in battery on chosen sites less in advance.

The reason which had prevented Canrobert on the 10th March from consenting to seize the then unfortified Mamelon proved

* *Todleben*, Vol. I., pp. 34, 35.

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sufficiently strong to deter him from assaulting the embryo work which had newly grown over its surface.

To our people the notion of suffering the enemy to construct a defensive work on the one path which could lead our Allies to the Malakoff, seemed almost the same as abandoning the main design of the siege; and to deprecate such acquiescence, our chief engineer drew up a memorandum "on the expediency of occupying the Mamelon" which Lord Raglan imparted to Canrobert*; but all this insistence proved vain; and the Mamelon, growing daily in strength, continued to remain unassaulted.

Meanwhile Lord Raglan succeeded to a certain extent in allaying the apprehensions of the French commander who thought it possible that when the Allies should open their fire upon Sebastopol, the enemy would attempt a general attack, making a sortie with 20,000 men on the extreme left of the French, and at the same time the right of our position with 40,000 men, and the ground in front of Balaclava with an equal force by a simultaneous movement.

"In those times of trial," said one who best knew Lord Raglan, "he would calmly withhold his assent to all gloomy apprehensions, and throw upon those who conversed with him the spell of his own undaunted nature. Men went to him anxious and perturbed. They came away firm." †

"I think," said Lord Raglan, "our friends are a little uneasy, and are anxious for the arrival of some of the Turkish Army from Eupatoria; but they continue to have full confidence in their English Allies."

On the night of the 22nd March the enemy undertook an adventure with a much greater number of troops than are commonly charged with the task of making a sortie in darkness. He effected four sorties against his English besieger, thus extending the front of his great night attack, but still threw the main weight of his onslaught on that chosen part of the ground where our French Allies were engaged in sapping their way towards the Mamelon. The night was dark, and a strong wind intercepted the sound of troops marching, when at about 10 o'clock nine battalions of infantry, commanded by General Khrouleff, moved out from the flanks of the Kamtchatka Lunette along the Victoria Ridge; and another battalion assisting, it was with a strength of no less than 5,500 men that the Russians soon came into action.‡

The French "guards of the trenches," that night were under General d'Autremarre and comprised four battalions.

* Despatch "Secret" to Secretary of State, March 17th, 1855.

† Speech of General Airey to the Board of General Officers.

‡ Khrouleff was the General repulsed by the Turks when assailing Eupatoria.

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Though not without some hard fighting, General Khrouleff's battalions recovered the lodgments which their adversary had been suffered to occupy, advanced to the head of the sap, and invaded the foremost "approaches," whence, after encountering a brave and stubborn resistance, they at last drove in the French working parties. After leaving in the "approaches" thus seized, a large number of sailors who wrought all the havoc they could, Khrouleff's force moved on in pursuit.

Here, however, by this time were gathered the three French battalions which d'Autremarre had within reach; and his force now opposed to the Russians a resistance so strong that those of them who made bold to adventure beyond the parallel met their deaths, whilst those who remained on its verge soon found themselves engaged in a hot and obstinate fight.

To the enormous preponderance of numbers already enjoyed by the Russians there now came a new and unexpected advantage, for a little body of troops had by this time moved up along the edge of the Woronzoff Ridge; and then it came to pass that the French whilst engaged against the host in their front suddenly found themselves stricken by a fire from across the ravine, and from ground so far south that it took their troops in reverse. Under this serious trial the French showed great firmness; and on the other hand the enemy failed to obtain any encouragement from the sight or sound of the fire newly befriending him.

His masses still remained hanging back on the verge of the parallel and apparently with the loss of their headway they lost all their clearness of purpose. There were glimmers of light in the sky which enabled the French to see that their assailants were gathered into bewildered groups, and in need of sure guidance.

The onset had spent its force, and the counter-sway followed. Whether simply, as von Todleben says, obeying their General's repeated signals, or yielding as Niel asserts to the prowess of d'Autremarre's force, the assailants at all points fell back. They were pressed for a while in retreat, but soon found shelter beneath the guns of the fortress.

The field officer that night on duty in the English trenches of "Gordon's Attack" was Colonel Kelly; and of the 1,200 men under him, one-half at first guarded the third or foremost parallel, which may be said to have crossed the whole breadth of the Woronzoff Ridge, from the Dockyard Ravine on his right to the Woronzoff road on his left.

With 300 of his men Colonel Kelly had furnished the working parties employed that night under the guidance of Colonel Tylden, R.E., and the remaining 300 he kept higher up in reserve. Colonel Kelly had the advantage of having at his side Major Gordon (the

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directing engineer of the Gordon's or "Right Attack" siege works) who thoroughly well knew the ground.

Directed by Ensign Zavalchine, the attack planned against our right flank was opening with some shots from his skirmishers, when under the orders of Boudischeff, and designed to take effect on our front, a much heavier onslaught began.

Greatly favoured by the darkness, and also by the roar of the wind overpowering the sound of their march, a body of Russian troops, supposed to be about 800 strong, moved out from the lines of Sebastopol, and ascended the Woronzoff Ridge. It was opposed by a small detachment of the 97th Regiment comprising about 80 or 90 men commanded by Capt. Hedley Vicars. During the fighting Gordon who was with Colonel Kelly received a wound from a musket shot which struck his right arm and disabled him; but Colonel Kelly running forward overtook Capt. Vicars, and was presently moving down alongside him against the enemy's column. It is supposed that baffled by the darkness, the Russians failed to divine the scantiness of the small force that assailed them with a strength of only about one to ten, for when the advance of our soldiery was becoming or had already become a charge the Russians fired a last volley; and then, still hanging together after the manner of Russians in flight, began to retreat at the double, its rear files turning however and firing back shots as they ran. By one of these shots Capt. Hedley Vicars, who was moving eagerly forward at the side of Colonel Kelly, was killed. Colonel Kelly at last stopped the pursuit, and brought back the 97th detachment to its former post at the trench. From this time, about midnight, until one other hour had passed all was quiet on the Woronzoff Ridge. But again at 1 o'clock in the morning the tumult of more fighting began to make itself heard; and the seat of conflict this time was a part of the Ridge further west.

During the *mêlée* that ensued, Colonel Kelly saw a group of seven or eight soldiers whom he took in the darkness to be men of his own regiment—the 34th. So going close up to them he directed these men to fall in with the other men. He was met by an uproar of outlandish cries, and found that he had been accosting the enemy. Whilst attempting to defend himself with his revolver, the trigger of which was held fast by the safety-catch, he was felled by blows laid upon him with the butt ends of muskets, and was bayoneted in the right shoulder, in the left hand, and in the right leg and was only saved from being killed by a brave young Russian officer who interposed, and in shielding him became the recipient of some of the fiercely-aimed blows, and caused the wounded Colonel, as a prisoner of war, to be brought safely into the fortress.

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The conflict drew to a head on the site of a new mortar battery occupying the trench during its centre. The enemy advanced on this battery from the west, the English from the east, and within it the two forces met, each moving with bayonets fixed alongside the parapet, and of course therefore facing the traverse. At the first traverse the Russians made a protracted stand. Colonel Tylden came up in person, and his own idea apparently was to execute a charge straight forward from east to west along the foot of the parapet; but our people instead, with a rush, drove their way round the end of the traverse, overthrew at the point of the bayonet all they then found before them, and pursuing, approached the next traverse where the enemy made his last stand. Colonel Tylden by one charge more overcame the resistance they offered, drove all the Russians out of the battery, and pursued them some way along the course of the trench, but the fugitives before very long were all over the parapet and making off towards the Redan.

The two English detachments engaged in this part of the field lost three officers and several men.*

Whilst this combat was raging, yet one other sortie began, and was directed against our Left Attack. A column commanded by Béruleff, about 500 in number, moved out against the foremost trench at the base of Green Hill which was afterwards called the 4th Parallel.

Favoured greatly as had been other columns by the darkness and the roaring of the wind, this column surprised and drove in the detachments of the 20th Regiment which had lined the parapets of the advanced trench. A great number of the assailants entered the two new and incomplete batteries No. VII. and the advanced No. VIII. which had been established in the 3rd Parallel, there surprising the working parties, which under Capt. Montagu, R.E., were engaged in thickening the parapets. Lieut. Carlton, of the 21st Fusiliers, collected his own little force, about 50 in number, adding to it some men of the 57th whom he found within reach, and then at once opened fire on the hesitating conquerors of the advanced trench who were then brought to bay.

Lord Raglan highly commended the gallantry with which officers and men, called from their toil with pickaxe and spade, had met the successive emergencies, and not confused by the darkness or putting all their trust in cartridges, proved able to drive off the masses one after another by simply the use of the bayonet.

* Capt. the Hon. Cavendish Browne, of the 7th Fusiliers, and Lieut. Jordan, of the 34th, were killed, and Lieut. McHenry, of the 34th, wounded.

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Our Allies, all this time, both above and below the earth's surface had been pressing their siege operations against the town of Sebastopol, whilst the British with scantier numbers, and besides on more difficult ground, had been slowly pushing forward their batteries against the Redan and its neighbours. Lord Raglan did not wish to oppose the conjoined wishes of the French and Turkish commanders; and at this time Omar Pasha was brought to the Chersonese with from 15,000 to 18,000 men supported by 30 guns. Towards the end of February the Russians sank six more of their ships in order to more effectually close the Roadstead.

In the command of the Russian forces, Prince Mentschikoff was succeeded by Prince Michael Gortchakoff; and General Osten-Sacken was placed at the head of the Sebastopol garrison.

On the 17th March, the Russians lost their valiant Admiral Istomine, a cannon ball killing him whilst standing by the Kamtchatka Lunette.

Pursuant to the early decision of Lord Palmerston's new administration General Harry Jones on reaching the Crimea was at once put in orders as the commander of our engineers, and Sir John Burgoyne being apprised of the instructions recalling him ceased of course to hold power officially at the seat of war. But Lord Raglan believing at that particular time that the continued aid of Burgoyne would be of great value to the public service, requested the General to remain for a while at headquarters. This Burgoyne did, and it was only in the third week of March that he left the Crimea. Lord Raglan addressed to Burgoyne a letter expressive of the grateful appreciation with which he regarded his services.

The April Bombardment.

The Allies had now in the month of April decided upon a bombardment of Sebastopol on an immense scale, and had expended great efforts, undertaking to deliver their fire with 501 guns which (with the exception of 31) were of great calibre; and for the service of all this artillery they had collected a vast amount of ammunition. Of the 501 pieces only 123 were English, the rest being French; but in aggregate weight of metal, the difference was less; computed in that way the proportion of the French siege power to that of the English was only as sixteen to thirteen.*

Of the 998 guns which by this time they had established in battery, the Russians could bring into action against the now threatened attack, as many as 466, with an aggregate weight of metal which

* "The weight of projectiles thrown by the French pieces of ordnance in one salvo was 15,957 lbs.; by the English, 13,333 lbs.; combined salvo, 29,290 lbs."—*Todleben*, Vol. II., p. 164.

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compared with their adversaries, was as twenty-three to twenty-nine. On the whole, it seemed plain beforehand that in this artillery conflict the balance of advantage was strongly against the besieged.

On Monday, the 9th of April, the morning opened with heavy mist, storm, and rain, so that each object was thickly obscured, but nevertheless, soon after daylight, the cannonade was commenced.

In almost every bastion some 20 or 25 minutes were suffered to pass before the Russian batteries opened. At the end of that time the garrison began to answer, but were firing with a rigid economy of ammunition; and this very unequal interchange of artillery missiles had not gone on for many hours, when the richly-supplied besiegers were seen to be having the mastery. All day, the besiegers went on with their great cannonade, which, even when darkness fell, did not relapse, the defences being plied at night with a powerful vertical fire.

From the 10th, to the close of the 18th April, the Allies continued to work their guns with destructive effect. But the enemy laboured indomitably, always at night-time, though still more or less under fire, and never failed before morning dawned, to repair the broken defences and restore the artillery power.

With some little help from our people, the French siege guns broke down the most precious defences of what was called the "Town Front," and again in the opposite quarter, silenced the two "White Redoubts" on Mount Inkerman, whilst our British artillery mastered the interposed batteries of the Kamtchatka Lunette which had blocked all approach to the Malakoff.

The official narrative tells us that on the eve of this April bombardment General Dacres preferred a request, one not however conceded, that in order to complete his arrangements, the opening of the fire might be postponed for 48 hours.* What caused General Dacres to ask for delay was the backwardness of certain preparations in the Left Attack.

Before evening on the 11th April, the ground had become much more firm than it was on the days preceding; and when our left siege-train commander directed Capt. Oldershaw, of the Royal Artillery, to take down the guns meant for the arming of the advanced No. VII. he was answered by a cheerful "All right, sir," that had the ring of decisiveness.

With the aid of 300 infantrymen, Capt. Oldershaw opened a road through the parapet of the 2nd Parallel, brought his guns through

* *Journal of the Royal Engineers*, Vol. II., p. 145.

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the passway, and before morning, lodged them all safely in the advanced No. VII.

The advanced No. VII. of our Left Attack was the battery destined to be fought on the 13th April by Capt. Oldershaw, and on the 14th by Capt. Henry. It was one of two batteries in the 2nd Parallel of our Left Attack, and was not only in close proximity to the enemy's frowning defences, but was so low down as to be commanded from most of the ramparts. The little advanced No. VII. was placed so forlornly as to be openly inviting a fire of almost indefinite power. The distance of No. VII. from the Crow's Nest (the nearest of the enemy's guns) was only about 700 yards.

On the evening of the 12th, Capt. Oldfield (the officer commanding the artillery of the Left Attack) ordered Capt. Oldershaw to work the No. VII. Advanced Battery on the next day.

Long before sunrise so as to be under cover of darkness Capt. Oldershaw moved down into the work, having with him one subaltern, one surgeon, and 65 gunners. There four guns stood planted in battery, and a fifth one was near them, but lying in its travelling carriage. It was with the four guns already established in battery that Oldershaw undertook to fight.

Capt. Oldershaw now found himself engaged against five batteries, and undergoing the concentrated fire of their twenty heavy guns. For a while the chief's losses in men went on faster than the disabling of his guns ; and there soon came a time when, with three pieces still undisabled, he could barely find sufficient unstricken men to work them. Still, all who could, toiled heart and soul, and one of these was Oldershaw's subaltern, Lieut. W. R. Simpson, a zealous and valiant officer. At this period of the fight, Capt. Oldershaw sent off a messenger to the 1st Parallel to ask for reinforcements.

With all the power left them our gunners still answered the storm of the enemy's fire, but their guns of course after a while had been wrought by incessant discharges to a state of intense, scorching heat, and could only be fired at intervals.

A hollow shot entered the embrasure through which Oldershaw was laying his gun, and achieved what is perhaps unique in the annals of gunnery conflicts ; for killing two, wounding the rest, and yet sparing the Captain himself, it laid the whole of the gun detachment at its feet. The gun was disabled. It had twice before been struck by a shot without becoming unserviceable. So of the four guns with which Oldershaw had begun the conflict, only one now remained intact. With that one gun, however, the Captain still continued to fight.

Capt. Oldershaw had maintained the unequal combat for five hours, when at length a superior officer came down into the battery

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and directed him to retire. The detachment at first comprised 65 gunners. Of these 18 men at the close of the fight had been sent away by Oldershaw with orders to bear off wounded men. Of the remaining 47, the enormous proportion of 44 were either killed or wounded, so that the remnant of the original body with which Oldershaw at last marched out of the battery mustered only three.

On the day of the fight the Brigadier-General Commanding (afterwards Sir Richard Dacres) rode accompanied by his staff to the tent of Capt. Oldershaw, and there thanked him personally for his exploit of that morning saying, "You fought your battery nobly, and are an honour to your regiment."

The advanced No. VII. was restored and prepared for new fights with so great despatch as to be again in working order on the next day, the 14th April, and its sister work, No. VIII., having at last been armed, the fight of the previous day was renewed.

On that day the advanced No. VII. was commanded by Capt. Henry, of the Royal Artillery, having under him Lieut. Conolly and 35 men. Capt. Henry engaged the barrack batteries, and they answered him with a power that soon proved him to be hugely overmatched; whilst he was also assailed front and flank by the Garden Batteries, besides being placed under the strong enfilading fire of the left face of the Flagstaff Bastion. Out of his small force Capt. Henry lost two men killed and five wounded. From each of his 32-pounders he fired about 100 rounds, but one of his guns was after a while disabled. Kept under a powerful fire for nearly eight hours, the battery and its embrasures suffered havoc.

With their siege guns in this bombardment of ten days the Allies are believed to have fired some 130,000 shots, and to have been answered by the Russians with about 88,000.

Though inflicting on the Russians huge losses, the artillery conflict cost the French and the English together no more than a few hundred men. Of this loss in killed and wounded a large proportion, as usual, was borne by our sailors. They were masters of the art of bantering the enemy by making humorous signs to him, sometimes a seaman standing up on the top of the parapet teasing by gestures the Russian officer when seen to be bending his field-glasses on one of the batteries, or by the favourite prank of extinguishing his own mirthful head beneath an inverted bucket. To say whether this great bombardment did or did not open paths for assault, it is right to hear the voice of authority. Commanding on this subject more weight than any other man, General von Todleben answers the question. He wrote that the "French might have advanced to the assault of the Flagstaff Bastion with an absolute certainty of success, and this so much the more since they found themselves

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at a distance from it of only some hundred paces." After stating that the Allies had planned assaults and failed to execute them he goes on to say :—" It is thus that the Allies failed to profit by the important advantage they had gained ; yet they had it completely in their power to take the Flagstaff Bastion, and that would have carried with it the fall of Sebastopol."

The Siege from the 9th April to the Middle of May.

On the 11th of April the French, and indeed the Allies, sustained a painful loss. Whilst making his way along one of our unfinished trenches, General Bizot was struck by a shot, and the wound some days later proved mortal. Commanding the French engineers he had pursued his huge task with a zeal that never relaxed. General Bizot died on the 15th April, and Lord Raglan together with those of his Staff who could be spared from their imperative duties, showed the feeling with which they regarded the brave engineer by following his remains to the grave.

General Bizot had scarce breathed his last, when the French carried into effect a design he had long entertained, and had long been seeking to execute. At the close of that series of mining operations which he had devised for the purpose, they at length on the evening of the 15th brought about some convulsing explosions, which opened up from below a line of volcano-like craters, at a distance of less than 100 yards from the counterscarp of the Flagstaff Bastion, and thus formed in front of the work a long deep cavity, interrupted, it is true in one place, but forming elsewhere what might almost be called a ravine.

This artificial opening of the ground close to and in front of the Flagstaff Bastion became for the French a beginning of their 4th Parallel, and, though not until after hard struggles, they were ultimately able to establish themselves in the hollow, taking care of course to connect it with their 3rd Parallel, full 100 yards less in advance, by covered lines of way.

Passing yet further west to the front of the Central Bastion, Colonel von Todleben at this time began to construct new works on the zone then dividing his lines from the French, by establishing lengthened chains of rifle-pits which he had taught the Allies to distinguish as "lodgments"; and, as previously on Mount Inkerman, and the Victoria Ridge, General Canrobert appeared to be reluctant to make any resolute stand against the encroachments.

General Pelissier at this time only commanded a corps ; but these as it chanced were the troops challenged and defied by this last growth of new Russian works thrown out in advance of Sebastopol ; and although he was only a subordinate owing obedience to the

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Commander-in-Chief, was by nature so constituted as to be in hot rage at the notion of quietly enduring the enemy's audacious encroachments. He seems to have got his way over Canrobert, and was either empowered or suffered to make war against the "lodgments."

Pelissier determined to attack them on the night of the 10th April, but the Russians, on the same evening withdrew their troops from the lodgments, and prepared to ply the new occupants who might soon be there with a powerful fire of artillery from the Central Bastion.

Between 9 and 10 o'clock in the evening the French advanced in some strength, and planted themselves in the then empty lodgments, but were presently assailed by a powerful artillery fire. Under this ordeal the French held their ground firmly during several hours, but not without suffering losses. Then at 2 o'clock in the morning the enemy made a powerful sortie, retook at once two of the lodgments, and did not give himself rest until he had recovered them all. In like manner, on the nights of the 11th and the 12th there was a taking and retaking of these pits; but on the night of the 13th Pelissier caused them to be attacked in some force and destroyed.

In order to cover a somewhat weak part of his defences by a species of "counter-guard," Colonel von Todleben had established in front of his Schwartz Redoubt another strong chain of lodgments which were to make a beginning of the work designed.

These lodgments Pelissier seized on the night of the 12th April; but after dark on the 23rd, the strife was renewed. From that last night until the close of the month, the Russians not only remained masters of the lodgments, but deliberately converted them into a new work of counter-approach in the form of a redoubt, and so thrown forward as to be 141 yards in advance of the Russian line of defence and within 116 yards of the French siege works.*

This new work the Sousdal Counterguard was furnished already with nine 6-pounder mortars which, with the fire of the riflemen, were used to annoy the French workmen who toiled in their most advanced trenches.

General Canrobert grudged the loss that would have to be suffered in wresting this Sousdal Counterguard from the enemy, but Pelissier brought his Chief to consent that the attack should be made, and orders were given accordingly.

* Todleben does not deny that the extreme proximity to the enemy's siege works was a defect, but says its position was dictated by the lay of the ground. The new work was executed by troops of the Sousdal Regiment, and thence acquired its name.

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On the night of the 1st May, a strong body of French infantry, commanded by General Metterouge, advanced against the work in three columns.

Either in or about the work, the enemy at this time was present with no less than four battalions; but the Russians devoting their care to the task of repairing the havoc done in the daytime by French artillery, were said to have been off their guard, and to have been taken in part by surprise.

Without firing a shot, the assailants made good their advance to the edge of the work, and the centre column at once broke over the parapet intent on the use of the bayonet. Some fighting ensued but did not last long. The centre column prevailing soon drove out the Russians, pursued them some way in their flight, and was master of the counter-approach including its nine little mortars.

With admirable valour and skill the French engineers, under Colonel Guerin, hastened to clench the victory. Reversing the parapets of the captured work, they connected to the use of the French what so lately had sheltered the Russians, and achieved under fire the perilous and difficult task of forming by flying sap the gabionaded approach, full 350 yards long, that would link to their system of trenches the newly effected conquest. The conduct of the French troops, that night, was as Lord Raglan said "very brilliant."

It was not without making sacrifices that the French achieved this conquest of the lodgments. In killed and wounded they lost about 600 officers and men; the Russians 425.*

On the following day the French strengthened themselves yet further in the conquered work, and afterwards at about 3 o'clock they promptly repulsed a sortie which the Russians attempted against it.

On the night of the 13th, they repulsed a new sortie attempted against the work, as also one made further west.

On the night of the 20th April the enemy had determined to make a sortie to prevent the British from seizing the lodgments confronting the left advanced sap of Gordon's Attack; but our people anticipated him by 24 hours; and it was at 9 o'clock on the evening of the 19th April that, commanding in person a detachment of his splendid 77th Regiment, Colonel Egerton assaulted the lodgments These he promptly carried, but suffered some loss, and Capt. Lemprière of his regiment was killed.

In one of the captured lodgments, our engineers resolved to

* "The French losses at the Battle of the Alma were not, it seems, quite so great as those they sustained in this combat."—*Niel*, p. 241.

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establish a lodgment of their own, and to connect it with the head of their sap. This, though only of course incompletely, they found means to do in three or four hours. They determined that they would not retain the other lodgment; but some men, eight or ten, were left there on watch for the time.

At about 1 o'clock the Russians advanced with a whole battalion of their famous Vladimir Regiment reinforced by some hundreds of men volunteering from its other battalions. The assailants drove in our covering sentries, and the eight or ten soldiers left watching in the otherwise unoccupied lodgment. Then advancing against the lodgment which our people had resolved to hold fast, the Russian force moved in its strength; but the British coming up in good time soon drove back the Vladimir troops, thus defeating the enemy's efforts to reconquer what he had lost. Thenceforth accordingly the lodgment thus taken and held remained connected definitely with the siege works of "Gordon's Attack."

But this brilliant achievement cost our people some lives. Whilst forming his troops for the second of the two encounters Colonel Egerton was unfortunately killed. Lord Raglan reported the conduct of the troops to have been admirable. In killed and wounded, all reckoned, the losses were sixty-eight.

The real advantages achieved by these petty enterprises was of a general, not special, kind. They kept the besiegers on the alert, and made it their duty to go on unceasingly with the always harassing task committed to the "guards of the trenches."

Towards the end of the month of April the task of laying down a submarine telegraph cable connecting the Chersonese was brought to completion, and on the 2nd May the arrangements for communication were completed. Thenceforth a few hours sufficed for the passage of messages from either Paris or London to the camps before Sebastopol. There was also laid down a cable which connected the Chersonese with Eupatoria.

Lord Raglan towards the close of this period was happily strengthened in numbers by reinforcements of troops which were placed under his orders.

On the 8th May General de la Marmora, with a part of the 15,000 Sardinian troops despatched to the seat of war, and followed by the rest of the force, was already landing at Balaclava, and placing himself, as agreed, at the British Commander's disposal.

Dr. Russell in his history of the siege says:—"It was impossible to deny to the Russian engineers great credit for the coolness with which they set about repairing damages under fire, but words could not do more than justice to the exertions of our own men, and to the Engineer officers and sappers engaged in this most perilous duty. When an embrasure was struck and injured it was the duty of the

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sappers to get up into the vacant place and repair the damage, removing the gabions, etc., under fire, and without the least cover from shot, shell, or riflemen. Our Engineer officers had frequently to set the example to their men in exposing themselves when not called upon to do so."

On May 28th a meeting was held in Pelissier's hut, at which the Generals of the French were present, three of whom were Engineers. On the part of the British, General Jones, R.E., and Colonel Adye, R.A., took part in the proceedings. At the meeting General Pelissier announced his intention of promptly assaulting the Mamelon and the redoubts in front of the Inkerman attack, known as the "Ouvrages Blancs," and requesting that the British should at the same time establish themselves in the Quarries in front of the right attack.

General Jones promised to lodge a force in the Quarries and clear the ground in front at the same time that the French crowned the Mamelon. A good deal of discussion took place for the next few days, at the end of which it was decided that fire should be opened from all the batteries for two days, and that on the evening of the second day the forward movement should take place on all three points simultaneously by signal.

By this time the following additions had been made in the British attacks :—On the left No. 10 Battery for seven guns in the centre of the 2nd Parallel ; No. 11 for eight guns on the extreme left of the same parallel, beyond No. 9 with a communication from it under shelter of the crest of the ravine ; No. 12 for four mortars to the right of No. 9, and No. 13 for four mortars in the 3rd Parallel between Nos. 7 and 8. In the right attack three new batteries had been thrown up, No. 13, or the Sandbag Battery, for four guns in the 2nd Parallel, to the immediate right of No. 12 ; No. 14 for five guns, in the same parallel, to the left of No. 9, and No. 15 for three mortars in a small quarry to the left of No. 12.

During the interval since the April bombardment the 9th Company, Royal Sappers & Miners, had also been added to the strength of the British Forces. On the other hand the following losses had been sustained :—Capts. King, Crofton, Lieuts. Baynes and Carter, killed ; Capt. Owen, wounded, and Capt. Porter and Lieut. Pratt, invalided.

It may here be mentioned that during the month of May a very successful expedition was made to Kertch and Yenikale where the Russians had accumulated vast masses of stores of every description. These were all destroyed, and after a few days spent in carrying devastation in every direction, the force returned to the duties of the siege.

On June 6th all the batteries opened at 3 p.m., and before sunset

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had done good service, the enemy's works being greatly knocked about. During the night the mortars were kept firing upon all the quarters where the enemy were likely to be engaged in restorations, and on the 7th the artillery fire recommenced at daybreak. At 6 p.m. that evening the signal was given and three simultaneous attacks delivered. One French column was directed against the "Ouvrages Blancs," a second against the Mamelon, and a British column against the Quarries. All three were perfectly successful. The Russians were driven out, and the first steps taken to connect these works with the besiegers' advanced trenches.

As regards the British attack, the troops were commanded by Capt. Shirley, of the 88th, acting as a General Officer. He was assisted by Lieut.-Colonel Tylden, R.E., who guided him as to the points of attack, and the distribution of the troops in the assault. The Royal Engineer officers employed in this brilliant operation, under Lieut.-Colonel Tylden, were Capt. Browne,* and Lieut. Elphinstone † in charge of the working parties, and Lieut. Lowry as guide to the attacking column. Capt. Wolseley ‡ and Lieut. Anderson also served with the working parties.

Lieut.-Colonel Tylden made the following report on the operations:—"The enemy's 'ambuscade' known as the Quarries, and the adjoining trenches in front of the left of the right attack, were stormed and carried yesterday evening about 7 p.m. by a party of 400 men from the Light and Second Divisions. A good lodgment has been formed on our right of the Quarries, and the communication from the left advanced sap made good. Our troops are at present in occupation of the Quarry lodgment, covering their left, extending from thence to the right along the reverse of the enemy's trench to his salient rifle pit at the centre. The whole of these works have been appropriated for our own use. The enemy's resistance was energetic and determined, evinced, not only in the defence of his Quarries, but in the repeated efforts he made during the night, to retake his trenches by turning their right, as well as by direct attacks. A reserve of 600 men formed the immediate support of the assaulting party, and a working party of 800 men was detailed for the forming of the lodgment.

"Communications, etc., were divided into four different parties, each for a special part of the work. Three of these parties I brought forward in readiness to commence work directly the enemy's trenches were taken, but such was the resistance of the enemy and his numbers, that the assaulting party and their reserve were

* Afterwards General Sir J. F. M. Browne, K.C.B., Colonel Commandant, R.E.

† Afterwards Lieut.-General Sir Howard Elphinstone, V.C., K.C.B.

‡ Afterwards Field Marshal Viscount Wolseley, G.C.B., G.C.M.G.

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insufficient to hold the captured trenches, and I quite concurred in the necessity of those portions of the working party who were armed being appropriated for this purpose. The last 250 men I kept in reserve in the right ravine communication, and as soon as the advance had been reinforced and regularly posted, I brought this party forward, and with them made the lodgment and communication. The former was effected under the immediate direction of Lieut. Elphinstone, R.E., and when the darkness of the night and critical circumstances under which the lodgment had to be made are considered, I think that this officer deserves the highest praise for the creditable manner in which he executed this service. Capt. Browne, R.E., who was the officer of Engineers in charge of the general superintendence of the work, and of the arrangement of the working parties executed these services to my perfect satisfaction. Capt. Browne speaks in high terms of the conduct of Capt. Wolseley, 90th Regiment, Assistant Engineer, who was employed in forming the communication to the lodgment."

"We have unhappily to regret the loss of Lieut. Lowry, R.E., an officer whose gallantry and untiring zeal, added to the experience he possessed from many months' service in the siege, adds another instance to recent losses in the Corps which we cannot replace, nor sustain without the deepest concern. Lieut. Lowry was the officer who conducted the storming party, which service he performed in the most gallant and conspicuous manner."

To these reports must be added General Jones's remarks on Lieut.-Colonel Tylden, which are as follows :—

"Lieut.-Colonel Tylden, of the Royal Engineers, distinguished himself particularly on this occasion, as well as on every other from the commencement of the siege, always at hand to aid in the repulse of the enemy whenever our works have been attacked."

After repeating Lieut.-Colonel Tylden's encomium on Capt. Browne and Lieut. Elphinstone, etc., he continues :—

"The Sappers & Miners were conspicuous, and by their gallantry and zeal obtained for themselves strong marks of approbation from His Lordship, the Field Marshal Commanding."

The next few days were spent in rendering secure the new acquisitions, and in constructing within them advanced batteries to play upon the line in their rear. Meanwhile fire was kept up more or less vigorously from most of the existing batteries. After a conference between the Artillery and Engineer chiefs of the two armies, which was held in General Jones's hut on June 10th, at which six French and two English Generals were present, plans were submitted for an assault on all points. The Generals-in-Chief, however, decided upon limiting the attack to the Mamelon and the Redan without advancing on the line in front of the French left.

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The Attacks on the Mamelon and the Redan.

On June 16th General Jones issued his orders as to the duties of the Royal Engineers on the occasion. The Redan was to be assaulted at three points—the right, centre, and left. The columns were numbered one, two, and three. Each was to be headed by an Engineer officer, with 10 Sappers provided with tools for removing obstacles, behind them a covering party of 100 men, then some men with bags of wool, and after them the ladder party. The main column was to consist of 400 men, to be followed by a reserve of 800 men, and lastly a working party of 400 men. The three columns were to be identical in strength and organization, and captains of Engineers were to accompany the officers commanding.

The following Engineers took part in the operation :—

Lieut.-Colonel J. W. Gordon, attached to Lieut.-General Sir G. Brown, who commanded the entire force.

No. 1 Column.—Major Bent, Lieuts. Murray, Graham, and C. G. Gordon.*

No. 2 Column.—Lieut.-Colonel Tylden, Capt. de Moleyns, Lieuts. James and Donnelly, and Major Campbell, Assistant Engineer.

No. 3 Column.—Capt. Jesse, Lieuts. Fisher, Graves, and Somerville.

There was also a fourth column which was to move towards the Woronzoff Ravine, and enter the works of the place beyond No. 3 Column.

The assaults failed in every direction, no column, either French or English, succeeding in establishing themselves within the enemy's works. There were two causes for these failures. First the attack was made before the fire of the garrison had been sufficiently crushed. Secondly, the French columns on the extreme right, which was intended to penetrate the line to their right of the Malakoff, started before the signal was given. The Russians were therefore fully prepared for the other columns when they left their trenches. The result was, as has been said, complete failure, coupled with severe losses, especially in officers.

Two Engineer descriptions of the British attacks were given, one by Lieut. Graham, who was with No. 1 Column, the other by Lieut. Fisher, who was with No. 3 Column. Graham's report was as follows :—

" In obedience to brigade orders of this day's date " (the 19th June) " I have the honour to inform you that at half-past three o'clock yesterday morning, I was in charge of the ladder party

* Afterwards Major-General Charles Gordon, C.B., the hero of Khartoum.

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accompanying the storming party, ordered to attack the right flank of the Redan, Brig.-General Sir J. Campbell commanding. On the signal for the attack being given Lieut. Murray, R.E., advanced in rear of the skirmishers towards the left, followed by the ladder party. The skirmishers did not advance beyond the rear spur of the hill, the fire from the Redan, Flanks, and Creek Batteries being too heavy. Lieut. Murray was here severely wounded, and obliged to retire. Lieut.-Colonel Tylden here came forward, and I had just obtained his sanction to advance on the salient instead of on the flank when he too was struck down by grape shot. The skirmishers now advanced towards the salient, followed by the sappers, and the party carrying the woolsacks and ladders, whom I halted in front of the advanced trench, in order that the skirmishers might cover us before we advanced. Finding, however, that the skirmishers could not advance under the formidable fire of grape and musketry from the Redan, I ordered the escalading party to retire into the advanced trench, which they did. After about 10 minutes the officer in command of the storming party, Lord West, told me that he was again about to lead out the skirmishers, and requested that I would take out the ladders. This I accordingly did, and the ladders were again brought to the front. Here, I beg to be allowed to remark on the remarkable steadiness and gallantry of the officers and men of the Naval Brigade, who formed part of the ladder party, and who suffered most severely on this occasion. As it was again found impracticable for the skirmishers to advance, the ladder party again retired, bringing in most of their ladders, though not without severe loss. After this no further attempt was made until the order was received for the supports to retire. I beg to call your attention to the steady conduct of the party of sappers, under Sergt. Coppin, 4th Company, Royal Sappers & Miners, especially to Private F. Perrie."

Lieut. Fisher reported as follows :—

"On a signal being given from the 8-gun battery, No. 9, I observed the skirmishers moved to the front in open order, and almost simultaneously the assaulting column advanced from the right of our position. I immediately led the Sappers to the front, followed by the remainder of the column in due order under Lieut. Graves, R.E. I proceeded at a steady pace to allow time for the ladder party to cross the two old Russian trenches which were in our line of advance. We were exposed to a heavy fire of grape and musketry as we advanced.

"On arriving at the abattis I looked back to see how the ladder party were coming on. I could not see a single ladder, the men having abandoned them or (as I believe was very general) been shot down in advancing. I observed the whole party to be very

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much reduced. I endeavoured to rally the men, but being unable to get together a sufficient force to attempt an assault in the face of such fire as we were exposed to, I ordered the men to get under cover as fast as possible among the irregularities of ground and shell holes which existed close to the abattis, in the expectation of the supports which I hoped would advance to our relief. Here they were shot down by the Russian soldiers, who stood on the parapet of the Redan to fire, as well as by the grape which continued to sweep through our force. After waiting some time for the supports to come, in vain, I felt with such a handful of men any attempt to assault would be madness. Accordingly I endeavoured to find an officer senior to myself to recommend him to retire. Failing in this I took upon myself to order a retreat into our trenches, which was effected, but I fear our loss was very great. The abattis, though not very thick was almost entirely uninjured by our fire. It stood from 5 to 6 ft. high above the ground. There were small gaps and weak places where men could push through. I did not attempt to pull it away with the grapnels as I considered the fire too heavy to justify me in exposing men so prominently at so short a distance from the work, our fire being insufficient to keep the Russian soldiers off the parapet from which they were firing on us. I am of opinion that under a less severe fire it would be easy to break it up by means of axes and the iron grapnels. I am not aware that any of our men passed the abattis. I regret to state that Capt. Jesse, R.E., was shot through the head while speaking to me. Lieut. Graves is missing. He is supposed to have been killed under the abattis." (Then comes a list of N.C.O.'s and privates of R.S. & M. killed and wounded). "I must not conclude without bringing under your notice the very gallant conduct of Sergt. Fandry, R.S. & M., whose steadiness in the advance and exertions in cheering on the men were most praiseworthy."

The Engineer casualties in this unfortunate business were Capt. Jesse, Lieuts. Murray and Graves, killed; Lieut.-Colonel Tylden, died of wounds; Major-General Jones and Capt. Bourchier, wounded. The only success gained on the occasion was at the left attack where the cemetery at the head of the Dockyard Creek was captured, and a communication made from it to the advanced trenches. This was effected by the promptitude and zeal of Lieut. Donnelly, R.E.

On June 28th the army had to deplore the death of the Commander-in-Chief, Lord Raglan. He had been for some time in feeble health; but there is no doubt that the recent disaster was the cause of his sudden collapse. He was succeeded by Lieut.-General Simpson, who for some months had acted as Chief of the Staff.

It was now determined to add greatly to our weight of metal,

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and no efforts were spared to establish fresh batteries, and to bring up the ammunition that so large an armament would require.

On August 16th the position on the Tchernaya, which was held by the French and Sardinian troops was attacked in force by the Russians. After a heavy battle the enemy were driven back with great loss.

On the following day the batteries opened a certain amount of fire, intended to prevent the garrison from annoying the advanced trenches, which were being steadily pushed nearer and nearer to them, especially in front of the Malakoff; and this fire was maintained with more or less intensity until the beginning of September.

By this time the following additions had been made to the British attacks:—On the Left six new batteries had been constructed. In the Right Attack also, six new batteries were formed. Two new parallels, the 4th and the 5th, with their communications, had been established, and a trench was pushed out in front of the 5th Parallel, towards the salient of the Redan, reaching to within 190 yards of it.

The losses in the Royal Engineers had been very heavy. Lieut.-Colonel Tylden, Capts. Jesse and Dawson, Lieuts. Murray, Graves, and Lowry had all been killed. Major Montagu and Lieut. James had been taken prisoners but the former returned to duty having been exchanged early in August. Many other officers of the Corps had been invalided, of whom Capt. Belson and Lieut. Somerville had died at Scutari.

On September 3rd the chief Artillery and Engineer officers of the two armies were once more summoned to assemble. They gave in their joint opinion "that the siege works have arrived at such a point that the assault ought to be given to the place after a short delay." They observed that the French left attack on the town had been stationary for a long time, no further advance being practicable. The British advance on the Redan could also not be carried further. At the Malakoff the French artillery had obtained a marked superiority, and in consequence the approaches were within 25 metres of the *enceinte*. Although it might be possible to push farther forward, and blow in the counterscarp, they thought the delay to enable this to be done would be prejudicial. The French extreme right attack in front of the Careening Bay (or little Redan) was also within 25 metres of the place, and could approach no nearer owing to the rocky soil. Under these circumstances "the moment to give the assault has arrived." It was decided that the principal attack should be on the Malakoff and little Redan.

"If we succeed in seizing and lodging ourselves securely in these works, the fall of the Karabelnaia suburb becomes inevitable."

It being decided that these were to be the main attacks, it was considered necessary to distract the garrison by subsidiary assaults.

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"For this purpose, as soon as the success of the Malakoff front shall appear certain, the English at a concerted signal should give the assault to the Redan, and the French would at the same time advance on the enceinte of the town."

This project was approved, and on September 5th the bombardment became general, every gun that could be brought into play having opened on that morning. The British batteries consisted of 202 guns and mortars, and the French of 627. The calibre of the British guns was, however, in many cases superior to that of their allies. By these figures it will be seen that the weight of bombardment was of a most stupendous character, far exceeding what had ever before been brought into play on a similar occasion.

On September 6th the orders were issued for the British assault on the Redan. The assault was ordered for 12 noon on September 8th. Punctually at that hour the French columns rushed from their trenches, and the Malakoff was in their possession in a few moments. As soon as the tricolour was hoisted on the parapet as a token of capture, the signal was given for the British advance on the Redan. The story of this attempt and failure is best told in the words of the two principal Engineer actors, Capt. Montagu, attached to the General leading the column, and Lieut. Ranken, who had charge of the ladder party. The report of the former ran thus :—

"Upon the signal being shown that the French were in possession of the Malakoff Tower, the order was given for the troops to get ready. Such, however, was the excitement of the moment, that 100 men or more mistook the order, and went over the parapet before it was possible to stop them, and it was found necessary to let them all go, although by doing so the ladder party under Lieut. Ranken had not sufficient time to get all the ladders on the move and placed before the assaulting party arrived, they having less difficulty in passing the abattis, the passing of which, however, did not prove any serious obstacle. The first parties formed and moved off very well, but after that the showers of grape and rifle balls, etc., upon the succeeding parties sent from the flank of the Redan and Garden Batteries caused the men to run to the head of the single sap, from whence, after a short halt to take breath, they made another rush towards the salient angle, but by this means they were no longer in regular formation. All the men crowded on the salient angle so as to be out of the way of the flanking fire. To prevent this first check, I obtained permission from the General to allow the men pressing up from the left of the 5th Parallel to go up the single sap and start from the head of it. After about two hours' heavy firing the men all returned to the 5th Parallel, and no further attempt was made during the afternoon. General

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Wyndham, who was in charge of the assaulting column, informed me that he had been inside the Redan with some 60 or 80 men who got behind a traverse and could not be induced to go further. . . I have great pleasure in informing you that Lieut. Ranken performed his very dangerous service to my great satisfaction, placing the ladders very judiciously, and he afterwards succeeded in making the descent and ascent such that the troops experienced no difficulty in getting up without ladders, and he has expressed himself perfectly satisfied with the conduct of the sappers under his charge. I regret to say that Capt. Sedley, R.E., who was in charge of the working party to form the lodgments, was wounded, also Lieut. Elphinstone, R.E., who was on duty in the trenches; and of the sappers two were killed, and eleven wounded."

General Jones, who was at the time too ill to move, insisted on being present. He was carried down into the trenches in a litter, and remained with General Simpson throughout the attack.

In addition to the casualties among the Royal Engineers, Major Chapman, 20th Regiment, Assistant Engineer, was mortally wounded and died on September 20th.

This was the last operation of the siege. The French had made good their grip on the Mamelon in spite of the most furious attempts of the Russians to secure that vital point.

There is no doubt that the British storm of the Redan, unsuccessful as it was, enabled their Allies to secure themselves within their prize. For two most critical hours the enemy were compelled to divide their forces, and to devote a large portion of them to the retention of the Redan. During those two hours the French were able to block up all the rear openings by which access was obtained to the Malakoff from the interior, and at the same time create a communication with the trenches. A flying sap was established to the crest of the counterscarp, and a bridge of planks thrown over the ditch. The troops were therefore poured into the work rapidly and without confusion or exposure. Unquestionably this operation was much aided by the distraction caused by the other attacks, although they all failed. Most fortunately, the one point that was secured was the key of the position. The Russians were well aware of that fact, and shortly after darkness set in they began that masterly retreat to the north side which reflects so much credit on those who planned it, and also on those who so steadily and quietly carried it out. Before midnight the first of the explosions took place, by which the magnificent forts erected at such cost to protect the harbour, were being destroyed by their own constructors, and a constant stream of men was observed to be passing across the bridge that led from the south to the north side of the town.

At the end of two days the British entered the place and occupied

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the Karabelnaia suburb, the French being posted in the town. A mixed commission was formed, composed of officers of both armies, to take an inventory of all ordnance and military stores that were found in the fortress, in order that an equitable division might be made between the two armies. Twelve British members sat on this commission.

The number of Engineer officers who from first to last took part in the Crimean War was sixty-nine. Of these thirteen were killed, six died of disease or accident, thirteen were wounded, and twelve invalided. Of the nineteen Assistant Engineers, two were killed, and five wounded. Of non-commissioned officers and privates of Engineers who landed in the Crimea, fifty were killed, ninety-two wounded, and sixty died of disease.

The following are approximately the numbers of the principal engineering materials used at the siege :—Common gabions, 17,015 ; iron gabions, 2,307 (these were made of the strap iron by which the compressed hay trusses were bound) ; fascines, 2,780 ; sandbags, 336,345 ; bread bags, 7,413 ; hide bags, 40.

The main object of the Siege of Sebastopol having been the destruction of the Russian fleet and the magnificent docks that had been constructed for its maintenance, the place had no sooner fallen into the possession of the Allies than orders were given to prepare a project for the demolition of the docks.

The docks were demolished by means of a series of three lines of mines, one under the centre of the floor, and the other two behind the revetments of the side walls, continued so as to meet round the semi-circular end. For the three docks there were 134 such mines, and 22 additional ones for the half of the basin that fell to the British share. As soon as this operation had been carried out the destruction of what was known as the White Buildings, an extensive range of barracks, was undertaken. The officers employed in this work, under Lieut.-Colonel Lloyd, were Major Ranken, and Lieuts. C. G. Gordon and G. Graham.* The demolition of the buildings was satisfactorily effected with one sad casualty. Major Ranken himself undertook to fire the form of four charges in the gable of one of the buildings at 5 p.m. This was to be done by means of a 3-ft. length of fuze. Unfortunately some loose powder became ignited, and exploded the four mines before Major Ranken could escape. His body was not found until the next morning when it was extricated from the ruins in a very mangled and crushed condition. This was the last British life lost in the war, and the sadness of the accident was accentuated by the fact that he had led the storming party on September 8th with the most dashing gallantry, and had escaped unhurt.

* Afterwards Lieut.-General Sir Gerald Graham, V.C., G.C.B.

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TRANSCRIPT.

ANTITYPHOID INOCULATION.

From the *Medical Record, U.S.A.*

FACTS as to the efficacy of antityphoid inoculation accumulate almost daily. Perhaps the most satisfactory statistics with regard to the value of the method are those afforded by the United States Army. As pointed out by Major Russell of the Medical Corps, U.S. Army, in 1911, it was made compulsory for all recruits in the army. The following figures showed the contrast between the state of affairs in the Spanish War and that in 1911. At Jacksonville, Fla., in the early campaign there occurred certainly 1,729 and probably 2,673 cases of typhoid fever with 248 deaths. The strength of the force was 10,579. At San Antonio when an American army was concentrated on the Mexican border in 1911, 13,000 men were encamped for about the same length of time as in the Spanish War and among these were only two cases of enteric fever and no deaths, although the disease was actually present in the civil population of San Antonio and the troops were allowed to enter the town freely. According to Major Russell, in the army as a whole a great drop has occurred in the incidence of typhoid fever since inoculation was made compulsory. Reports from France are as favourable as those from this country. For example, during an epidemic of typhoid fever in Avignon, the garrison of the town consisted of 2,053 men, of whom 1,366 were inoculated. Among the unvaccinated soldiers 155 cases of typhoid fever with 21 deaths occurred, while among the vaccinated there was not a single case. All the soldiers lived under exactly the same conditions. Again, in Eastern Morocco among 962 vaccinated soldiers there was no case of infection, whereas among the non-vaccinated the morbidity was 38·22 and the mortality 5·51 per 1,000.

In the British Army in India the results of the method have been conspicuously brilliant. There the typhoid rate fell in five years from over 15 to under 5 per 1,000, and the death rate from over 3 to 0·63 per 1,000. During the year 1910 among about 70,000 men there was a total of 306 cases of enteric fever; 151 of these occurred in the 10,000 who were unprotected and only 155 in the 60,000 who had been vaccinated. Only 11·2 per cent. of the inoculated died and 16·1 per cent. of the uninoculated. It must be borne in mind that members of the white race in India are peculiarly prone to typhoid fever and that up to recent years this has been one of the main causes of sickness and death.

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Figures dealing with the efficacy of antityphoid inoculation in the Italian and Japanese Armies tend to show that the method has greatly decreased the death rate and morbidity rate from this cause. The Italian statistics are especially favourable, while the heads of the Japanese Army have found antityphoid inoculation of so great preventive value that it has been made compulsory.

At the present juncture, the question is insistently of moment. Immense masses of men are gathered together in Europe under conditions necessarily the reverse of sanitary. In spite of all precautions typhoid fever is certain to break out, in fact, has already broken out. Consequently, any method calculated to protect individuals from contracting the disease should be employed without hesitation. Even if the method had not been proved to be as efficacious as it certainly is it should be practiced. When an authority of the rank of Sir William Leishman declares that not only is antityphoid vaccination efficacious but the subsequent ill-effects are slight and fleeting, a view which is endorsed by the great majority of the British medical profession, and when Professor Chantemesse of Paris goes so far as to state active belief that typhoid fever will gradually disappear during the present century just as small-pox vanished in the nineteenth century and when Italian and Japanese authorities, who have tested the method, are practically unanimous in giving evidence as to its value, scepticism must, to a great extent, vanish.

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REVIEW.

THE LIFE OF GENERAL SIR HARRY N. D. PRENDERGAST, R.E., V.C., G.C.B.

By COLONEL H. M. VIBART, late R.E. With 25 Illustrations, including a Photogravure of Sir Harry Prendergast. Price 15s. net.—(Eveleigh Nash, 36, King Street, London, W.C. 1914).

THIS Memoir of a very distinguished officer, who has recently passed away, is a welcome addition to the library of biographies of Royal Engineers, who have brought honour to the Corps to which they belonged, as it not only gives an admirable account of his life and services, but also contains much useful Corps history, especially as regards work in India, of which Sir Harry Prendergast had the good fortune to see a great deal both in peace and war.

Prendergast came of an ancient family of warriors, originally Flemish, one of whom, Maurice, went over to Ireland in the twelfth century, when that island was a happy hunting ground for men of military capacity, seeking to gain fortune by the sword. From him descended Sir Jeffrey, grandfather of the subject of this volume, the first of the family to serve in India, who was born in 1769, a year which produced several remarkable men, including Wellington and Napoleon. This Jeffrey had a distinguished career, commencing with a period of imprisonment in France during the great war, whence he succeeded in escaping to Switzerland. The account of his experiences as a prisoner of war will be read with special interest at the present time when a number of our country people are imprisoned in Germany. On returning to England he received a commission in the Madras Army and served for forty years in India, retiring in 1835, when he was promoted to the rank of major-general.

Sir Jeffrey's son, Thomas, was one of the East India Company's civil servants, and held a number of important appointments in the Madras Presidency during the thirty-two years of his Indian career. He had two sons, Hew and Harry, both of whom received commissions in the Madras Engineers, of whom the former joined as second lieutenant in 1850, and retired with the rank of major-general in 1887. Harry, the younger brother, joined at Addiscombe College in 1852, where he was specially distinguished in athletics. He was a member of the cricket eleven, a good fencer and boxer, and proficient with the oar; but his prowess in sports did not interfere with his studies, and, in 1854, he was given a commission as second lieutenant in the Madras Engineers. After passing through the usual course of instruction at Chatham in military engineering and survey, he embarked for India

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in 1856, and, soon after his arrival, was posted to the Madras Sappers, a corps with which he did important service.

Prendergast's active military service commenced almost immediately, as war was declared with Persia in November, 1856, and B Company of the Madras Sappers, to which he belonged, formed part of the British Expeditionary Force under the command of General Sir James Outram. The campaign was of brief duration, as, after the British had advanced up the Shatt el Arab River, and captured the Fortress of Mohumera on the east bank, the Persians gave in and peace was concluded in March, 1857, when the troops returned to India. The Madras Sappers were highly praised by General Outram for the zeal and activity they had displayed in the advance and assault on Mohumera, and it is interesting to call to mind that the Engineers have again very recently distinguished themselves in the advance up the same Shatt el Arab against the Turks, whose territory is on the west bank of the river from Fao to a point between Mohumera and Busra.

But, although the Persian War was at an end, B Company did not return to Madras as the Indian Mutiny had broken out, and, on landing at Bombay, Major Boileau who commanded it, asked that the company might be allowed to join the column, which was about to be sent from Poona against the mutineers in Central India. His request was at once granted, and the company joined the Deccan field force in July at Aurungabad, where a column was formed under the command of Brig.-General C. Stuart, which reached Mhow in August, where a halt had to be made on account of the monsoon. Two months later, a force, to which Prendergast, although only a second lieutenant, acted as brigade-major, captured the fort at Dhar, and, soon afterwards, General Stuart marched with the Malwa field force to Mundisore where the rebels were completely defeated and Prendergast won the V.C. for saving the life of Lieut. G. Dew, of the 14th Light Dragoons. He was badly wounded and had to return to Mhow, but recovered in time to take part in the brilliant campaign conducted by Sir Hugh Rose (afterwards Lord Strathnairn) with the Central Indian field force in 1858, during which the strong fortress of Jhansi was captured.

Prendergast's account of the Siege of Jhansi, quoted at considerable length by Colonel Vibart, is very interesting and gives a good idea of the hard work that fell to the lot of the Engineers, work of which Prendergast had his full share, and he was again severely wounded. His services met with well-deserved recognition, as, in addition to getting the V.C., he was recommended for promotion to a brevet majority on reaching the rank of captain. The official notification of the recommendation for the V.C. was as follows :—

"For conspicuous bravery on 21st November, 1857, at Mundisore, in saving the life of Lieut. G. Dew, 14th Light Dragoons, at the risk of his own, by attempting to cut down a Velaitie who covered him (Lieut. Dew) with his piece from only a few paces to the rear. Lieut. Prendergast was wounded in this affair by the discharge of the piece, and would probably have been cut down had not the rebel been killed by Major Orr. He also distinguished himself by his gallantry in the actions at Ratghur and the Betwa when he was severely wounded."

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Sir Hugh Rose, in forwarding the recommendation, wrote :—

"Lieut. Prendergast, Madras Engineers, was specially mentioned by Brig.-General (now Sir Charles) Stuart for the gallant act at Mundisore where he was severely wounded; secondly he was specially mentioned by me when acting voluntarily as my aide-de-camp in the action before besieging Ratghur on the Beema River for gallant conduct—his horse was killed on that occasion; thirdly at the action of the Betwa, he again voluntarily acted as my aide-de-camp, and distinguished himself by his bravery in the charge which I made with Capt. Need's troop of H.M.'s 14th Light Dragoons against the left of the so-called Peishwa's Army under Tantia Topee; he was severely wounded on this occasion."

This was a fine record for a second lieutenant, and was the auspicious commencement of a distinguished career.

The severe wounds received in the Mutiny Campaign necessitated two years' sick leave, and, much to his regret, Prendergast was not allowed to take part in the China Campaign of 1860, but he recovered sufficiently to return to duty in Madras by the end of that year, and held various appointments until 1867 when he had his next turn of active service, as Sir Robert Napier was appointed to the command of an expeditionary force to Abyssinia, in order to rescue certain persons, who had been imprisoned by King Theodore in the fortress of Magdala. Major Prendergast was sent in command of three companies of the Madras Sappers to make arrangements for the landing of the expedition at Zulla Bay, and for its transport to Senafé, the secondary base, in the highlands of Abyssinia.

It was to a large extent an Engineers' war; piers had to be constructed for landing the troops and stores, a railway laid to the foot of the mountains, and roads traced up the long and difficult passes, which rose, at their summit, to 7,000 ft. above sea level; it was satisfactory that Sir R. Napier was in command, as being an Engineer officer himself, he was thoroughly competent to direct the operations and to appreciate the work done by his brother officers, while his diplomatic skill in dealing with Kassai, Prince of Tigré, afterwards King John of Abyssinia, had no little effect in insuring the success of the campaign.

The *résumé* of the war given by Colonel Vibart is very interesting, but the map is not altogether satisfactory, as there are a number of important places mentioned in the text, which are omitted, and, on the other hand, places of less importance, not referred to in the text, are shown on the map. It would have been better if the latter had been prepared so as to read with the former.

The advance from Senafé was made in January, 1868, and, by April, the expeditionary force had arrived in the vicinity of Magdala. After a sharp fight with the Abyssinians, in which Prendergast had his part, Theodore retired into the fortress, and sent the prisoners to the British camp. Magdala was then attacked and captured, when the King committed suicide and the campaign was brought to a satisfactory

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conclusion. For his good work in this war Prendergast was made brevet lieutenant-colonel after only 14 years' service in the Army. On his return to India he was selected for the command of the Madras Sappers, an appointment which he held for 12 years, during which he did much to improve the efficiency of the Corps, and was respected and loved by the officers and men who served under him. In 1875, he was promoted to the rank of colonel and was given the C.B.

The next military expedition out of India upon which Prendergast was employed was in 1878, when a force of about 7,000 men was sent from India to Cyprus during the Russo-Turkish War, and the Engineers, composed of two companies of Madras, and two of Bombay Sappers, were placed under his command. They disembarked first at Malta, and then went on to Cyprus, where they had plenty of work, but no fighting, and matters in Europe having settled down, the army returned to India. On rejoining at Madras, Prendergast was appointed Military Secretary, and, in 1880, became brigadier-general in command of the troops in Malabar and Cannanore, whence he was transferred in the following year to Bellary. But he did not hold the appointment long, as, in 1881, he was promoted to the rank of major-general after only 28 years' service. His advancement had been very rapid, indeed too rapid, as after events proved.

In 1883 Prendergast was selected for the command of the British Burma Division, and joined at Mandalay in April. At that time the country was tranquil, but there were signs that Thebaud, King of Burma, was likely to give trouble, as he was in correspondence with the French Government, and was developing a policy of hostility to the Government of India, which could not be allowed to go on unchecked. In October, 1885, the Indian Government sent him an ultimatum, to the effect that a British agent should be permanently stationed at Mandalay, and at the same time, a British force was organized under General Prendergast to back up the ultimatum. As the King sent a defiant reply to the letter, orders were sent to Prendergast to occupy Mandalay and dethrone the King; he was told that these objects were to be attained if possible by the display rather than by the use of force, so that the task was by no means an easy one, but it was admirably carried out.

General Prendergast left Rangoon on November 12th, with a force of about 9,000 men, British and Indian; and, by November 29th, the frontier fortresses on the Irrawaddy had been captured, the Burmese Army dispersed, and King Thebaud dethroned and sent as a prisoner to India. The manner in which the work had been done was well summed up in the following letter from Lord Dufferin, the Viceroy:—

"I cannot rest content without conveying to you in a more permanent form than a telegraphic message my high appreciation of the manner in which you have conducted the whole of the Burma business. It does you the greatest possible credit; and I am happy to say that your services have been fully appreciated both at home and in India itself. The Queen is delighted, so is the Secretary of State, and so is

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the Government of India. One of the characteristics of success is that it excludes from public observation the fact that, in the hands of a bungler, the result might have been very different; and we have already received sufficient information in regard to the difficulties with which you have had to cope to convince ourselves that it is rather to your skill and good management, than to any exceptional easiness of the task you were commissioned to fulfil, that so satisfactory a conclusion of the affair is to be attributed. Had there been only a little mismanagement, any unnecessary delay or less promptitude of decision, the conquest of Burma would have probably cost us many valuable lives, and greatly aggravated our future difficulties. As it is, thanks to your skill, prudence and humanity, and your rapidity of execution, we have attained our ends with little loss to ourselves, or to Her Majesty's future subjects. This circumstance will enable us, of course, the more readily to shape our eventual policy. Again congratulating you upon the well-deserved honour conferred upon you by Her Majesty, as well as on the high place to which your recent achievements have raised you both in the eyes of the English and of the Indian public, believe me, my dear Sir Harry, yours sincerely, DUFFERIN."

After the successful occupation of Mandalay, Prendergast led an expedition up the Irrawaddy to Bhamo, an important strategical point on the river 250 miles further north, upon which a Chinese force was advancing from the east. This move he carried out on his own initiative, as the necessity for action was pressing, and there was not time to obtain authority from the Indian Government; but his rapid move received the complete approval of the Viceroy, as it prevented serious political complications with China.

For his services in this very successful campaign, Prendergast was made a K.C.B. Soon after its conclusion he felt the disadvantage of too rapid promotion, as he became lieutenant-general during the war, and, Burma being a major-general's command, was ordered back to India. This was regarded by his friends as a grievance, and there was some criticism of his action in Burma, due apparently to the action of a *Times* correspondent, who had been sent out of the country for indiscretion. One is inclined to think that Prendergast would have preferred that such matters had been left to rest, but they are dealt with at unnecessary length in the Memoir, which is rather to be regretted. No one in Sir Harry's high position can expect to go through life without incurring some criticism, and meeting with some difficulties, and the subject was well dealt with in a letter from Lord Dufferin in which he said:—

"The one fact which history will record, and the only fact which I am sure at this moment remains present in the minds of your countrymen, is that in the course of a fortnight you conquered a kingdom and overthrew a dynasty; and this in consequence of the vigour, the celerity, and the judicious character of your operations. . . . We said to you 'Go and take Thebaud and occupy Mandalay,' and you did both with scarcely the loss of a man."

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After leaving Burma, Prendergast took furlough to England, and, on his return to India was appointed Officiating Resident at Travancore, and, in 1889, was made the Governor-General's Agent at Baroda. He was also Resident at Mysore and Chief Commissioner of Coorg from 1891 to 1892, when he finally returned to England after 36 years' service in India. In 1902 he was given the G.C.B., a well-earned honour, and, in 1908, he became Colonel Commandant of the Royal Engineers. But though he had retired from Government service he led a most useful life, and always worked for the welfare of the Corps to which he belonged. He is well described as "The Happy Warrior," on the title page of Colonel Vibart's volume, which we hope will be read by the young officers of the Corps who will learn from it much that will be helpful in their passage through life, and they will do good work for their country, if they follow the bright example of Sir Harry Prendergast.

CHAS. M. WATSON.

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NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

October, 1914.

AERIAL COMBATS.

In one of the last numbers of the *Kriegstechnische Zeitschrift* there appears an interesting article on aerial combats, a subject which has been the object of many discussions and theories which are far from agreeing one with the other. The article in the German periodical is a *résumé* of a series of publications of the military writer, C. Dienstach, gathered from the *Scientific American*. The views of Dienstach refer essentially to the good results furnished by the German Military Press that were obtained from dirigibles armed with mitrailleuses, and the slight value that France is inclined to attribute to this armament in view of the always increasing capacity of ascension of the aeroplane.

It is an indisputable fact that in these later times aeroplanes, even with some passengers, have frequently reached a height to which it is not possible for a dirigible to follow without a considerable sacrifice of gas and ballast. The lessons which ardent aviators have brought to their country after traversing the Pyrenees and the Alps, in France, tend to consider fighting in the air exclusively from a point of view of gaining the greatest height, like a battle between artificial birds of prey. As there seems no doubt that the aeroplane can attain a greater height than the dirigible the French conclude that the final victory should remain with the first. The problem, however, is not so simple as it appears, and is deserving of a more careful examination. Altitude appears a decisive factor, since it is admitted that an aeroplane with its greater velocity can freely rise above the dirigible, and in a state of relative immovability can destroy the dirigible by simply throwing a bomb. The fallacy of this French deduction is at once revealed when contrasting the velocity of a falling bomb with that of a mitrailleuse projectile.

With regard to a dirigible armed with a mitrailleuse, the aeroplane cannot approach without great risk, to discharge its bomb, at less distance than 600 m. Besides, the aeroplane has to fly with the same velocity, and in the same direction, as the dirigible if it is to have a probability of striking. Now, it is clear that for an aeroplane, when dropping a bomb on a target on the ground, the same conditions have to be determined when the target is a dirigible in motion. In the first case it is necessary to consider its own velocity and the approximate distance of the ground, whilst in the second there are two velocities to be considered, and the relative distances of the two aerial machines, and this is not easy. The aeroplane has to take into account its greater

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velocity in order to keep itself above the dirigible, and to take aim at a target in motion with a fair chance of striking the latter from a height of 600 m. Such is the theory, but other factors have to be considered, and especially the great precision of fire of the modern mitrailleuse that renders it dangerous to the aeroplane within a large area around the dirigible. Besides, the stability of the dirigible which can fire quietly and at ease, and the modern precision of the sights, are factors which have to be taken seriously into account. Contrasted with the fire from modern mitrailleuses, the throwing of a bomb from an aeroplane is like the mediæval custom of pouring pails of boiling pitch. A bomb takes 13 seconds to fall from a height of 600 m., which gives sufficient time to avoid the unwelcome visitor from the sky. In the clear atmosphere of the higher regions an observer on a dirigible can with a good field glass follow continuously the movements of an aeroplane 600 m. above him, and it is certain that the throwing of a bomb cannot pass unobserved, even in mist, with the strong searchlights with which the great dirigibles are now provided. A short electric signal to the pilot can effect a rapid deviation. Owing to the great speed and the efficiency of the rudders the dirigible may be found at a great distance at the moment at which the bomb arrives from above. Nor is it to be supposed that a dirigible will easily permit an aeroplane to attack it from above. It can manœuvre continuously without prejudice to the accuracy of fire from its armament. A projectile fired from a mitrailleuse pointed at a great elevation can traverse 730 m. in a second, notwithstanding the slight correction for the resistance of the air. The aeroplane would certainly not have the same facility of aiming for dropping its bomb. It is also impossible to determine by the eye if the vertical direction is effectually above the dirigible, nor can one calculate the trajectory of a bomb dropped under such conditions. Without a special field glass fixed vertically the most capable pilot would not be able to keep the aeroplane for any time vertically in a position above the dirigible. Besides, the aeroplane has to contend against the wind, which does not affect the dirigible to the same extent. There exists then great difficulties for an aeroplane wishing to throw a bomb on a dirigible from above, which render success problematical. Again, the fact that the small bombs of aeroplanes, of limited weight and of relative large surfaces, in traversing the strata of air of different densities are subject to deviations, which become increased with the distances. There seems then only to be one expedient, that is, to give an armoured protection to the car of the aeroplane, to enable it to approach nearer to the dirigible, but this entails the danger of being capsized by the eventual explosion of the latter. With the fire from mitrailleuses, which can cut through a tree, it is not possible to give armoured protection to the propellers, which must always remain vulnerable. On the other hand if the aeroplanes have armoured protection the dirigibles may be armed with small cannon in place of mitrailleuses. The attempt would perhaps be made to arm the aeroplanes with mitrailleuses; it would then be a question of a combat with firearms for both sides, which would put an end to the tactics of the falcon now badly applied. Doubtless, in the fight between two aerial machines, both armed with

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mitrailleuses, the advantage would remain with the aeroplane because the dirigible with its superior mass could not compete in front of a fleet of small aeroplanes. But the greater capacity of the dirigible would admit of its having on board a gun which with its longer range would always be able to keep the aeroplane at a distance and to destroy it before coming under the range of fire of the aeroplane's mitrailleuse. There would be no material inconvenience to a dirigible provided with a small cannon, as a gun of this kind would be almost as easily manageable as a mitrailleuse. It cannot be denied that the considerations of the American writer have a certain value as opposed to the opinions of those who think that the dirigible must be a prey to the aeroplane. Pending the results of practical experience no one for the moment should arrogate to himself the right of a definite judgment on the question which should be considered calmly and without preconceived ideas.

Dienstach in another article treats briefly of the combat of aeroplanes with one another. The Turkish and Bulgarian aeroplanes at the lines of Chataljia were limited to exploration work, but the immense European War with Germany now in progress furnishes many examples of combats between aeroplanes. The author concludes that only the experience of the future will be able to furnish lessons. This is fully brought out by several cases which have occurred in which at the decisive moment brave aviators have not hesitated to sacrifice their lives and their machines for the good of their country.

November, 1914.

NOTICES.

Mortars of 30·5-*c.m.*, *Model* 911.—From the *Jahrbücher für die deutsche Armee und Marine* we extract the following notices :—Trials made with a mortar of 30·5-c.m., Model 911, against a target constructed with reinforced concrete, 18 m. wide and 9 m. in depth. 151 shots were fired from a distance of 8,000 m., of which 90 struck the target. Of the latter, 21 were direct hits. A block of cement 1·50 m. thick was completely destroyed. An armoured turret, 15 c.m. thick, was entirely perforated.

Cyclist Companies.—From the pages of the *Internationale revue über die gesamten Armeen und Flotten* the following report is taken on the constitution of the Austrian-Hungarian cyclist companies :—In Austria-Hungary there are only four companies of cyclists, which are the fourth companies of the rifle battalions (11th, 20th, 24th, 29th). Each company is subdivided into four sections, of which the 1st, 2nd, and 4th are cyclists; the 3rd Section is for mitrailleuses. Each company also has a sanitary patrol. The cyclists are armed with repeating carbines, Model 96, of 8-m.m. calibre, carried on the back. In each section the knapsacks and the cloaks are carried on a motor-car. The Mitrailleuse Section consists of two mitrailleuses with relative detachments, and of 20 cyclists carrying ammunition. The mitrailleuses and their carriages are carried on ordinary flexible bicycles conveniently modified. All the bicycles are provided with a bag fastened behind the saddle. These bags contain the cartridges. The bicycles for the sanitary patrols are not flexible,

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but are constructed in such a manner that they can easily be transformed into litters. These can be used as stretchers for carrying the wounded, or attached to bicycles ridden by cyclists. Each company is provided with signalling apparatus for visual signalling by day or night, telephonic material, sappers' tools, and explosives. Usually the sappers' tools and the explosives are carried in one of the motor-cars of the company. In case of need these tools and half the explosives can be carried by the cyclists of the 4th Section, which are equipped with bags fixed behind the saddle of the bicycle. The greatest care is given in the instruction of the company cyclists in exploration work and in musketry.

BULGARIA.

Consumption of Artillery Ammunition in the Balkan War.—At the commencement of the war against Turkey, Bulgaria arranged for about 1,000 rounds for each field gun. The consumption in the greater part of the regiments in the campaign varied between 450 and 500 rounds per gun; but in some others it amounted to over 800 rounds. Reinforcements were effected partly by acquisitions made during the war, and partly from Krupp projectiles captured from Turkey. During the whole of the war, including the campaign against Servia and Greece, the consumption for each gun amounted to about 1,076 rounds per gun. At the conclusion of peace the batteries had only 40 rounds for each gun. Following the experience gained Bulgaria has arranged for the future that, in peace time, 1,500 rounds shall be held ready for each field artillery gun.

FRANCE.

Telegraph Service for Cavalry Divisions.—The telegraph service for cavalry divisions, as referred to in the *Jahrbücher für die deutsche Armee und Marine* for August, gives the following regulations (War Service, 2nd December, 1913) :—The director of the service is a captain of engineers attached to the staff of the division, and has at his disposal a cavalry telegraphist detachment for the service of the cavalry light telegraph, and a telegraph section. This (composed of 1 sergeant, 1 corporal, 5 telegraphists, all mounted on bicycles) is commanded by a lieutenant on the Reserve. These telegraph sections for cavalry divisions are not formed at the moment of mobilization, being selected from various corps. The *personnel* in time of peace is united near to one of the regiments of the division, under the orders of a lieutenant who is responsible for the military and technical instruction. At the time of mobilization the telegraphist detachment becomes part of the general staff of the division. Such a detachment comprises 1 officer, 3 non-commissioned officers, 18 cavalrymen, 6 cyclists, 3 light wagons; and is subdivided into three equal sections. Each detachment contains 6 transmitters and 6 Morse receivers, 6 visual apparata of 10-c.m. diameter, 9 telephonic stations, 9 intermediate stations, 9 k.m. of telegraph wire, and 18 k.m. of wire on 18 drums per telephone. Each section fixes 3 k.m. of telegraph line in an hour, and 6 k.m. of telephone line in the same time. For visual communication a searchlight is used; if with petrol it projects the light 5 k.m. by day and 15 at night; used

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with acetylene 8 to 25 k.m. respectively during the day and during the night.

Transport of Cartridges for Companies.—The *Internationale Revue über die gesamten Armeen und Flotten* for September gives the following information :—The carriage for cartridges for a company has two wheels and is drawn by two horses ; the weight unloaded is 380 k.g., loaded 1,300 k.g. ; it contains two boxes with 12,928 cartridges each, total 25,856, besides 200 empty bags for cartridges. The ammunition in the boxes can be carried in the bags. In that case the load is less ; or precisely 25,856.

Calculating 200 rifles per company there are disposable per man :—88 cartridges carried by the man ; 129 cartridges carried on the company wagon ; total 217.

For the transport of the cartridges for the section-mitrailleuses they use improvisionally the old battalion carriages transformed for four horses, weighing, empty, 1,100 k. and 1,900 k.g. loaded. They contain behind 18,000 cartridges in belts and in front 1,500 in belts, and 2,400 in boxes. Each car thus carries 21,900 cartridges.

GERMANY.

The Greatest Cannon in the World.—We read in the pages of the *Mitteilungen über Gegenstände des Artillerie-und Geniewesens* that in the range for fire for Krupp's factory near Meppen trials have been made with the largest gun in the world. This gigantic cannon has a calibre of 38 c.m. and is 17 m. in length. The charge weighs about 2 quintalis. The cost of each round fired is about 10,000 marks. With this gun the range is said to attain to 24 k.m. (15 miles). The complete expenses for the gun, including the placing of it in position, are said to amount to about 400,000 marks. The periodical mentioned above does not give any other details of the gun.

E. T. THACKERAY.

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BOOKS RECEIVED.

MANUAL OF TRAINING FOR JUNGLE AND RIVER WARFARE. Illustrated by Photographs and Sketches by the Author. By Major Gordon Casserly, Indian Army. Price 3s. 6d. T. Werner Laurie, Ltd., Clifford's Inn, Fleet Street, E.C.

SPON'S ARCHITECTS' AND BUILDERS' POCKET PRICE BOOK, 1915. Edited by Clyde Young, F.R.I.B.A., and Stamford M. Brooks, F.R.I.B.A. 42nd edition. Price 2s. 6d.; 2s. 8d., post free, U.K. E. & F. Spon, Ltd., 57, Haymarket, S.W.

BUILDING CONSTRUCTION DRAWING. A Class-Book for the Elementary Student and Artisan. By Richard B. Eaton. Part II. 26 plates. Price 1s. 6d.; 1s. 8d., post free, U.K. E. & F. Spon, Ltd., 57, Haymarket, S.W.

THE SHADOW OF THE SWORD. By Capt. A. F. V. Green, R.A. Price 1s. Wm. Clowes & Sons, Ltd., 31, Haymarket, S.W.

DRILLING MADE EASY. By Fred G. Shaw. Price 3d. F. G. Shaw, Neville Court, Abbey Road, N.W.

THE SOLDIERS' ENGLISH-GERMAN CONVERSATION BOOK. Compiled by Henry Buller. Price 7d. T. Werner Laurie, Ltd., 8, Essex Street, W.C.

THOU ART THE MAN: THE STORY OF A GREAT CRIME. War Book Series. By Sidney Dark. Price 1s. T. Werner Laurie, Ltd., 8, Essex Street, W.C.

LOVE LETTERS TO A SOLDIER. By May Aldington. Price 1s. T. Werner Laurie, Ltd., 8, Essex Street, W.C.

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NOTES ON THE HARDENING AND ANNEALING OF STEEL.

By CAPT. G. H. WILLIS, M.V.O., R.E.

(*Read at a recent meeting of the Institution of Mechanical Engineers, Calcutta and District Section*).

HEAT treatment of steel is attracting every year more and more attention from the physicist, the chemist, the steel maker and the user. The Faraday Society last November had a general discussion on the hardening of metals to which I am indebted for part of the notes which follow. I extract two items which struck me from the report of this discussion which appeared in *Engineering* of November 27th.

Sir Robert Hadfield mentioned in his contribution that "he had quite recently received from Mr. Bhandarkar, the Superintendent of Archæology in Western India, a specimen of a metal containing 0·7 per cent. of carbon, which was really a steel in the modern sense, whilst the many other steels which had been sent to him were iron. The specimen, from the base of the stone pillar of Heliodorus (the name of the Greek who erected it) at Besnagar, dated from 125 B.C.; it was a plate ½ in. thick, weighing ½ lb., which could still be hardened by heating and quenching, showing that it had undergone no change of structure in two thousand years beyond surface oxidation." As dwellers in the land which produced this the most ancient piece of steel known, this discovery is of special interest to us.

The other extract is from the report of the written communication of Doctor J. E. Stead, and runs: "The fact is we have not sufficient data to found any definite conclusion as to why steel is hardened by heating to above Ac_{1-2-3} followed by quenching." Hence I think I may, without personal blame, claim that the subject I have the temerity to bring before you to-night is one of which very little is really known. My excuse for this temerity must be first, that this session was likely to suffer from a paucity of papers, and secondly, that I have been giving some time to an investigation of the matter, which would have been much more thorough and consequently much more useful had I more time at my disposal. The conclusions,

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such as they are, that I have arrived at after my investigations I now lay before you in the hope that even if I am unable to give you any new facts or ideas yet I may call your attention to some small points which may be of use to you in your work.

There are among the older school of engineers those who claim a complete knowledge of steel hardening and annealing, the result of long experience, but a very cursory examination of their claims soon proves an ignorance as vast as their self-satisfaction. For instance, you will be told that experienced steel hardeners can judge with great accuracy the temperature of hot steel by the colour, and this irrespective of the brightness or dullness of the day, and the state of the man's health. Either of these factors is sufficient to upset completely a man's judgment, and actually it will be found by testing the claimant of such powers against accurate instruments that he cannot gauge temperature to 50° C. There are many empirical beliefs which have grown up round the practice of the heat treatment of steel which have no real *raison d'être*, such, for instance, as the statement which has been gravely made to me that the reason for the good work done at Sheffield is to be found in the nature of the water there. Those who advance such a theory are ascribing to a fictitious cause their own inability to outdo or even to equal the work of those who have been born and brought up in an atmosphere of steel and consequently are able to obtain results that the rest of us would willingly purchase at a great price, though (tell it not in Sheffield) even the Sheffielder has been known to fail, and that badly, in the treatment of his own steel.

Turning now from the practical to the theoretical side we have those who, by chemical analysis, microscopic investigation, and other subtle tests, prove to us that all we have to do in order to get our steel hard or soft is to produce within it by our treatment certain forms of iron carbides, pearlite, martensite, troostite and others, *ad lib.*, or to alter the quantity of carbon in solid solution in the iron and there we are. But these doctors disagree among themselves with a wonderful unanimity and, at the best, their investigations are so far confined to ascertaining the results of any process, and though in the end, doubtless, the data obtained will be most valuable, for the present they do not much help the man who desires to harden or to anneal properly a given piece of steel.

During my investigation I visited not only several representative steel makers' works at Sheffield but also the shops of certain firms who specialize in the heat treatment of steel, and by comparison of what I saw and what I heard at these various works I arrived at certain conclusions, which, while they will not be new to all here, will, I hope, be useful to some.

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Special steels containing vanadium, tungsten, etc., were really outside the scope of my enquiry, and they differ so in composition and properties that a large book would be necessary to deal with them. On the other hand we, as mechanical engineers, are all brought daily into contact with carbon steels, and any guide to the right treatment of these should be of use. The theory advanced by certain of our scientific guides and the one which I accept for the present as best accounting for the results obtained in practice, is that steel heated to the recalescence point loses at that temperature its normal crystalline structure and becomes amorphous, *i.e.*, the molecules are of all shapes, or if you prefer it, without shape. Roberts-Austen thus expressed it some years ago :—" When iron passes through the temperature of recalescence its molecular constitution is for an instant almost chaotic."

Hardening of Carbon Steels.

When carbon steel is heated the rate at which its temperature increases is regular until a point a little above 700° Centigrade is reached. The rate suddenly diminishes at about 732° or 733° momentarily and thereafter resumes its regular course, save that there are two more minor interruptions at higher points with which we have at present no concern. This critical temperature called Ac_1 by the scientist is the recalescence point, and it is at this point that the steel assumes the amorphous state. Incidentally also carbon steel loses its magnetic properties at this point and is not attracted by a magnet. This latter principle is made use of by one inventor most successfully for the hardening of small steel tools, etc., and he has endeavoured to extend the principle to larger work, by fixing a magnet in the furnace which is released by the steel at the critical temperature ; on release it completes a circuit ringing a bell, thus giving the attendant notice that the recalescence point is reached. This loss of magnetism can however only be utilized in the case of carbon steel, any of the alloy steels are quite unsuitable.

Now it has been found by actual experiment that in steels containing a high proportion of carbon the closer the temperature of the steel to the recalescence point, so long as it is above that point, the harder the result on quenching. Hence, apart from another and very serious disadvantage which I touch on later, it is economically and practically wrong to heat the steel much above that point, as it is a useless waste of time and fuel.

For some reason, which I do not dare to attempt to explain, the crystalline form of steel is soft compared with the amorphous state, and the steel hardener therefore fixes the steel in the amorphous state obtained by heating to recalescence. This he does by quenching in a cool liquid, water for instance, and it is on the rapidity

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with which the whole body of the heated steel is brought below the recalescence temperature that the efficacy of the treatment and the resulting hardness of the steel depends. The hardening of a given carbon steel depends then on two things, heating of the whole body of the steel to the recalescence point and very rapid quenching, also of the whole body of the steel to a temperature well below the recalescence point so as to prevent the steel from assuming again its crystalline form, a process which takes some appreciable time.

Now when the structure of the steel has been successfully fixed in this amorphous state, there appears to be little room for doubt that the steel itself is in a condition of great internal stress, and it is perhaps due to this stress that the steel is hard. A fact that has come under my personal observation tends to confirm this view very strongly. In the Calcutta Mint a number of die blocks were got ready for an anticipated rush of work which did not come. They were stored away in their hardened state for a long time, many months in fact, and when taken into use a considerable number were found to have developed cracks and could not be used, while of the remainder the majority cracked very early in use and their average useful life was incomparably less than usual, and also than that of freshly made dies struck up from the same steel and treated in the same way with the exception of the long storage. To my mind this is strong evidence not only of the internal stress in hardened steel but also of the yielding of the steel itself under a lengthy application of this stress. I feel sure that had these dies been left soft and hardened when required, or perhaps had they been tempered before storing instead of at the time they were put to work, they would have had the normal life when used.

Quenching Temperature.—Until we have tables giving accurately determined recalescence points for steels of all varying proportions of carbon, we must rely for our quenching points on the maker of the steel, or, far better, ascertain it ourselves by trial of test pieces cut from the steel we are dealing with by using pyrometers.

A firm with a very high reputation for the excellence of their hardening work informed me that they adopted the following procedure. On receipt of each new batch of steel thin discs are cut from the bars and nicked across the centre, so as to facilitate fracture when hardened. These discs are then heated to temperatures rising by 5° Centigrade from say 720° up to 820° Centigrade as ascertained by an accurate pyrometer and quenched. Owing to the discs being thin there is certainty that they are thoroughly heated through and also completely quenched. The hardened discs are then fractured along the fracture nick and tested for hardness, also being carefully examined with a magnifying glass. In this way the

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temperature for that batch of steel is fixed, and all the steel of the batch is worked at that temperature within as small a limit as 2° Centigrade. Samples taken from the finished stock of the firm show a remarkable uniformity of hardness under test, thus demonstrating that the method adopted is efficient.

Quenching Water.—Those whom I venture to call the empiricists contend strongly that the quenching water must be as cold as possible and advise various methods of application such as opposed jets. It would seem however that a difference of a few degrees in the water is of small account when compared with the great difference between the recalescence temperature, something well over 700° Centigrade, and that of even boiling water. Remembering that the rate of transfer of heat from one body to another varies directly as the difference in temperature between the two bodies, it still appears in practice that ordinary cold water gives perfectly good results, such refinements as adding ice not improving the result, nor so far as I am able to ascertain does the addition of salt.

Burning of Steel.—If in heating the steel the temperature be taken considerably above the recalescence point, or if the steel be kept at a temperature above that point for any considerable time, the nature of the steel changes, probably due to rearrangement of its carbon contents. As it is found that in steel so treated the fracture becomes coarser and coarser the worse the treatment, it appears reasonable to assume that the carbon originally in solid solution in the iron becomes separated and interposes carbon molecules or molecules of various iron carbides between the molecules of true steel. This may or may not be the true effect, but we who are concerned with results have to bear in mind that whatever does take place, it is detrimental to the quality of our steel. Great care should therefore be taken to heat no more than is necessary to ensure that the whole body of the steel under treatment has reached a temperature but slightly in excess of the recalescence point. Should the steel by carelessness or accident become coarse in grain through this cause it may be restored, at least partially, by several annealings in which it is brought very slowly up to the recalescence point *and no further* and then cooled as slowly as possible.

Annealing before Hardening.—There is a point that may be noticed which was impressed very strongly upon me by several of those whom I consulted. When steel is worked on by hammering it is put into a state of strain, and though it appears most probable that the strains are removed when it is heated to the recalescence point for hardening, it would appear safer to make sure that the steel is in its normal soft state before hardening. It is therefore suggested that any steel upon which work has been done should be first annealed and then hardened. There is then no possibility of stresses of varying nature and perhaps direction being caused in hardening.

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ANNEALING OF CARBON STEEL.

Perhaps it is rather putting the cart before the horse to deal with hardening before annealing, as more frequently annealing is the first process carried out in order to work the steel and produce the finished article which it is required to harden. But the short excursion into the theory of heat treatment with which I started my remarks on hardening seems to fall more naturally under that head.

As in hardening we wish to fix the chaotic or amorphous condition of the steel, induced by raising its temperature to the recalescence point, so in annealing or softening we have to avoid this amorphous condition and bring the steel back from the strained state induced by working it or by heat treatment to the natural crystalline form of soft steel. This, as you all know, is effected by raising the steel to the recalescence point or rather slightly above that point and allowing it to cool so slowly that it takes that internal structure which is natural to it. Now just as in hardening, the steel can be spoilt or so altered in structure as to be inferior, so in annealing also. By going much above the recalescence temperature or by keeping the steel soaking for a long time above that temperature during annealing we materially alter its internal structure for the worse. This is a very important point as it seems that, to some minds, it must be that prolonged heat will do what as a matter of fact is done only by prolonged cooling. Old workmen will frequently assert most strongly that to get steel soft it is necessary to get the temperature up and keep it up, and that the longer you do so the softer the steel, while they are careless regarding the true cause of softness and on withdrawing the steel to be annealed from the furnace will place the containing vessel on iron plates, which conduct away the heat rapidly, or in a draught of air. Any practice which results in too rapid cooling after heating will tend to give hard spots in the steel on the outside while the interior will be satisfactorily softened, just as in hardening inefficient quenching will fail to harden the interior of the steel, while the outside may be glass hard and flake off in use.

The best way to cool the steel after reaching the recalescence point is to draw the fire or put out the gas and allow the whole furnace to cool down with the dampers shut. Where the unavoidable delay of this method renders it impracticable the steel should be removed quickly from the furnace and buried in hot sand. If however it is, as it should be whenever possible, enclosed in a vessel of some sort, the vessel should be removed from the furnace, the steel being left in it, and placed on some non-conducting material such as firebrick or sand and out of any draught.

Furnaces.—Though perfectly good work both in hardening and annealing can be done in the old type of coal-fired flue furnace it

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is more economical and far more satisfactory to use the gas-fired muffle, and still better, the gas or oil-fired salt bath furnace. This latter furnace ensures an even application of heat to the whole of the outside of the article under treatment since the salt used being in a molten condition must perforce be of the same temperature throughout if occasionally stirred and must also be in intimate contact throughout with anything submerged in it. Previously the salts used had a tendency to decarbonize to some small extent the surface of the steel, but this has been got over, and the salt in addition to ensuring even heating acts as an efficient protector against oxidation of the surface. To prevent oxidation of the steel in a gas-fired muffle, a small luminous gas flame should be kept burning just inside the door. This will consume all the oxygen which may leak in around the door when it is shut, and does away with the necessity for packing the steel to be hardened in pots with charcoal, as must be done in the old type of coal-fired furnace. For those who have not seen the salt bath furnace, I may explain that it consists of an uncovered receptacle filled with a salt mixture of which barium chloride forms the major part, the receptacle being heated from below and round the sides with a bunsen flame of gas or oil. A pyrometer is fixed so as to dip into the salt, and the articles to be hardened are placed on a tray which can be lowered into or raised out of the molten salt as required. The raising and lowering of this tray, which is perforated, at frequent intervals during heating ensures evenness of temperature in the salt bath.

Temperature Measuring.—Pyrometers or heat gauges of some sort are absolutely necessary for efficient work, but it must be remembered that they must be frequently checked, if of the electric thermo-couple or the radiation type, preferably by means of some substance with a known melting point close to the region in which the readings of the pyrometer are of importance. Two useful melting points are 800° Centigrade, the temperature at which pure common salt melts, and 730° Centigrade, the melting point of an alloy consisting of 68·2 per cent. of copper and 31·8 per cent. of tin by weight. This latter is particularly suitable as the recalescence point of ordinary carbon tool steel is 732° or 733° Centigrade. Melting point gauges such as the Sentinel which are usually small capsules of alloys having known melting points are useful, both as a working guide to the uninstructed workman, especially the Indian, and as a rapid and fairly accurate check on a pyrometer.

These few notes may perhaps be usefully terminated by a summary of "Don'ts."

Don't imagine you can gauge the temperature of hot steel by looking at it. You cannot.

Don't throw the article to be hardened into the quenching water and leave it there, but hold it with the tongs or otherwise and move

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it through the water rapidly in several directions so as to sweep off the bubbles of steam which form and which will cling to the surface if this precaution is neglected, producing soft spots.

Don't get the steel any hotter than is necessary whether annealing or hardening, and don't keep it hot longer than is necessary to ensure the heat getting right through, otherwise in annealing you will get a coarse grain and in hardening you are likely to crack your work.

Don't forget to check your pyrometers fairly often as they are unfortunately not infallible, and it is probable that many complaints about the quality of the steel are due to the worker's own failure to work at the correct temperature.

Don't waste time and money on empirical recipes or on treatments suggested by the "practical" man unless careful experiment plainly demonstrates their real worth.

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EXPERIMENTS IN THE PHOTOMETRY OF SEARCHLIGHTS.

By H. M. EDMUNDS, Lieut., London Electrical Engineers, R.E.(T.).

SOME experiments have recently been made by the writer in the photometry of searchlights, and as the results may add something to the existing knowledge of the subject they have been collected with explanatory notes in the present form.

DEFINITIONS OF TERMS.

Candle power is a measure of the quantity of light, under specified conditions, available from any given source. Various standard sources of light exist, constructed in accordance with definite specifications.

The unit candle is used as one of the standards of reference. Other sources of light can be compared with it by means of a photometer.

The photometer is in reality a device for measuring illumination. A screen is moved between the standard and the light to be measured until the illumination on each side is equal. A white paper screen with a grease spot is the commonest form. The spot disappears from view when the illumination is balanced.

The unit of *illumination* is the illumination produced by one candle power at a distance of 1 ft. It is called *1-ft. candle.*

Lumen—the Unit of Flux.—The total area of a sphere of 1-ft. radius is 4π sq. feet.

The standard candle, or any form of standard lamp gives out its specified unit illumination in one direction only. If it could be made to radiate unit illumination in every direction then the total flux of light from such a source would be 4π lumens.

One lumen is therefore the quantity of light passing across unit solid angle from unit source.

Law of Inverse Squares.—It is one of the laws of optics (borne out by experiment) that the quantity of light or flux contained in any solid angle subtending from a source of light remains unchanged whatever the distance from the source.

From this the law of inverse squares follows by simple geometry.

That is:—Illumination varies inversely as the square of the distance from the source.

Brilliancy.—Surface brightness or brilliancy is a measure of the

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degree of concentration of a source of light. It is usually measured in candle power per sq. millimetre.

The electric arc is by far the most brilliant source of light as yet obtained. Various figures are given for its value and about 180 candle power per sq. millimetre is most generally adopted.

Searchlights.—A searchlight is a device for collecting the light from a given source and concentrating it within a narrow beam. It therefore produces an apparent candle power much greater than the actual candle power of the source.

The effective candle power of the source will be the apparent candle power multiplied by the ratio of the solid angle of the beam to the total solid angle of a sphere (or 4π).

In the case of a 3° beam this ratio is 5830.

Professor Blondel has stated that at great distances from a searchlight the apparent brilliance of the whole surface of the mirror is equal to that of the arc crater reduced only by the co-efficient of reflection. This is, of course, in the case of paraboloid mirrors only; in which every part of the mirror reflects the light in beams whose centre lines are parallel.

The apparent anomaly of this fact is explained by noting that although the area of the source of light is increased from the small dimensions of the crater to larger ones of the mirror, yet the angle of action is decreased in the same ratio leaving the total flux of light undiminished except for losses of reflection.

Radius of Action and Visibility.—By radius of action is meant the extreme useful range of a searchlight. The distance of any object from the observer is said to be the range of that object.

It is a generally accepted principle that the visibility of a given target varies inversely as the square of the distance between observer and target and varies directly as the illumination of the target.

These two principles are adopted in calculations of radius of action. They are incomplete and (under many circumstances) inaccurate but they serve a useful purpose in calculating the relative effectiveness of various searchlights.

Calling visibility, V.
Illumination of target, I.
Distance from observer to target, d.
Then $V = K_1 \frac{I}{d^2}$, K being used to denote some constant.

Assuming a perfect parabolic mirror, the illumination in the centre of the beam at any given distance will be independent of the *diameter* of the crater and directly proportional to the intrinsic brightness of the source of light. The only effect of increasing the diameter of the crater will be to broaden the beam thus illuminating

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a larger area at a given distance. The advantage of a broader beam is that any given point is under observation for a longer period in traversing at a given rate.

Assuming that the observer is at a flank of the light and at a distance short compared with the range, so that " d " may be used for distance of target from both searchlight and observer. Then :—

$$I=\frac{K_2}{d^2} \text{ for a given arc and mirror,}$$

and

$$V=K_1 \frac{K_2}{d^2} \times \frac{1}{d^2}=K_3 \frac{1}{d^4}.$$

That is :—With a given searchlight in perfectly clear weather the visibility varies inversely as the fourth power of the range.

The illumination of the target at a given range is proportional to the square of the mirror diameter and directly as the intrinsic brightness of the crater.

The latter fact is obvious, the former assumes a constant ratio of diameter to focal length in different size mirrors. In the case of two mirrors, one twice the diameter of the other and assuming an identical crater in each, the solid angle subtended by the crater on the mirror with the larger projector will be one quarter the size of that with the smaller mirror of half the focal length.

The solid angle of the reflected beam is equal to that of the incident, therefore the area illuminated at a given range with the double-sized mirror will be one quarter that of the other. Since the total flux of light given out by the crater and condensed by each mirror is the same, it follows that the illumination will be four times as great at a given distance with the mirror of double diameter.

Calling D the diameter of the mirror.

And i the surface brightness of the crater.

Then

$$V=K_4 D^2 i \frac{1}{d^4},$$

or

$$d^4=K_4 \frac{D^2 i}{V},$$

or

$$d=\sqrt[4]{K_4}\ \sqrt{D}\ \sqrt[4]{i}\ \sqrt[4]{\frac{1}{V}},$$

or in words :—

The radius of action of a searchlight varies directly as :—

(1). The square root of the diameter of the mirror.

(2). The fourth root of the intrinsic brilliancy of the crater.

The above conditions while useful in determining the relation between various dimensions of a searchlight and its effective range

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are misleading in implying a numerical dimension for the property of visibility. In the writer's opinion it is absurd to speak of one object being, say, twice as visible as another; but, having determined the limit of visibility in the case of one beam, one is able to forecast at what range a searchlight of different dimensions will give the same degree of visibility. For example, if the effective radius of action of a 90-c.m. beam is 1,000 yards we can safely assume that a beam from a mirror of 180-c.m. diameter would give the same visibility at $1{,}000 \times \sqrt{2}$, or 1,415 yards. This effective radius would also be given by superimposing four 90-c.m. beams.

Atmospheric absorption will affect the above conditions somewhat and will tend to reduce the differences of range between different beams.

EXPERIMENTAL RESULTS.

The experimental work was carried out at a point where it was possible to have concentrated and dispersed beams at various distances centred or adjusted as required for the purposes of the tests.

The photometer employed for the tests was a small portable instrument called a "luxometer," and made by Everett-Edgecumbe & Co., Ltd. It consists of a device for striking a balance between the illumination produced by the light to be measured and a standard source of light. The range of the instrument employed is from 0·005 to 2,400-ft. candles.

In the experiments the following points were investigated:—

(1). To determine the relative illumination from different beams in order to show the efficiency of the mirrors.

(2). Observations made of the illumination due to the same beams under different weather conditions to determine the effect of atmospheric absorption.

(3). To investigate the effect on the illumination of varying the focus of the beam.

1. *Relative Illumination of Different Beams.*—The following measurements were made with beams carefully focussed by the respective E.L.D.'s. The weather conditions were exceptionally clear:—

Description of Beam.	Condition of Mirror.	Distance in Yards.	Average Reading of Luxometer in Foot-Candles.	Apparent Candle Power.	Effective Candle Power.
1. 90-c.m. × 42-c.m. paraboloid	good	1,690	0·99	25,000,000	4,360
2. ,, ,, ,,	v. good	1,690	0·50	12,900,000	2,200
3. ,, ,, ,,	good	2,560	0·34	20,000,000	3,430
4. ,, ,, ,,	good	2,560	0·60	35,400,000	6,070
5. 120-c.m. × 60-c.m. paraboloid	v. good	3,440	0·83	88,300,000	6,750
6. 90-c.m. × 45-c.m. Maugin ..	good	3,440	0·19	20,200,000	3,470
7. 90-c.m. × 42-c.m paraboloid	fair	2,120	1·17	47,300,000	8,120
8. ,, ,, ,,	good	2,120	1·18	47,700,000	8,200
9. 16° dispersed	good	1,690	0·23	5,900,000	5,400

NOTE.—3° beams are assumed for 90-c.m. mirrors.
2° ,, ,, ,, ,, 120-c.m. ,,
3° × 16° for 16° dispersed.

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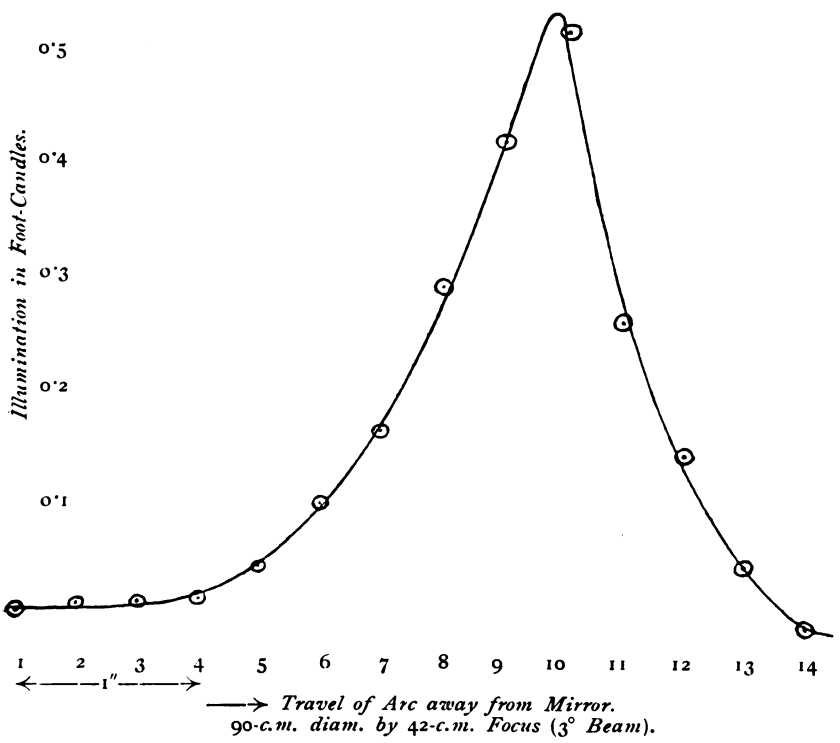
(2). *Weather Conditions.*—Beam at 2,560 yards 90-c.m. × 42-c.m. paraboloid.

Weather Conditions.	Foot-Candles.	Apparent Candle Power.
Very clear	0·96	9,700
Clear	0·58	5,880
Moderate rain, atmosphere clear ..	0·36	3,640
Thick weather, beams appear yellow	0	0

The results show that the difference between average clear conditions and very clear has a big effect on the atmospheric absorption. The first measurements were made after rain when an extraordinary clearness, very rare in England, was noted. The second reading was on what would be described as a clear night.

(3). *Effect of Focus on Illumination.*—A series of readings were made with a beam at 1,690 yards distance. The focussing screw of the lamp was moved two revolutions between each reading. The light in question had a paraboloid mirror 90-c.m. diameter by 42-c.m. focal length. The results are plotted in the curve and illustrate in a remarkable way the importance of accurate focus.

CURVE SHOWING EFFECT OF FOCUS ON ILLUMINATION.



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It is interesting to note that the E.L.D. at the searchlight considered the focus best at the positions 8 and 9 on the curve. In reality point 10 was 20 per cent. better than 9. This curve shows that an inaccuracy of half an inch in the position of the arc diminishes the illumination by approximately *one half*, thus emphasizing the importance of maintaining accurate focus for the best results.

Superimposed Beams.—As a useful check to the accuracy of the instrument for different illuminations several tests were made of two beams independently and then superimposed. The results showed a remarkable confirmation of the well-known optical law that the illumination of the combined beam is the sum of the illuminations of the separate components. This is of interest as observers in directing stations have often expressed a contrary opinion.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF DELHI.

June—September, 1857.

In the early months of 1857, signs of unrest began to be prevalent among the native regiments of the Bengal Army, but it was not until May that the outbreak of the Indian Mutiny actually burst forth in all its violence.

At the large military cantonment of Meerut, the headquarters of the Meerut Division, 89 men of the Third Bengal Cavalry had been tried by court-martial for refusing to use the cartridges issued from the arsenals, which they declared to be made with lard or pig's fat, thus destroying their caste and religion. They were sentenced to long periods of imprisonment, and heavily manacled, were removed to the military jail. On Sunday, May 11th, the native troops at Meerut broke into open mutiny, setting fire to the bungalows, releasing the prisoners, and murdering their officers, and any unfortunate Europeans whom they happened to meet. After committing these outrages they made off to Delhi and were not pursued.

On arrival at Delhi, being joined by the inhabitants of the city, they proclaimed the old pensioned King of Delhi as Emperor of India and committed similar massacres to those at Meerut, shooting down the English officers of the native regiments and murdering the Europeans. A force under the command of Brig.-General Wilson—afterwards Sir Archdale Wilson, G.C.B., marched out of Meerut on the 27th May and completely defeated the rebels with great losses on the Hindun River, capturing all their guns. After the junction of this force with that under the Commander-in-Chief, General Sir W. Anson, which had marched from Umballa, the combined forces under Major-General Sir H. Barnard (General Anson having died of cholera at Kurnul) marched towards Delhi and defeated the rebels who had taken up a strong position at Badle-ka-Serai on the Grand Trunk Road about 4 miles from the city.

The result of the successful action on the 8th June, 1857, at Badle-ka-Serai was to give to the field force under the command

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of Major-General Sir Henry Barnard complete possession of the low ridge of hills to the westward of the city. The highest parts of the ridge rise to a height of about 50 to 60 ft. above the general level of the interior of the city, while the average command may be taken for practical purposes at about 40 ft. The greatest length of the ridge occupied at any time during the preliminary operations was a little more than 2 miles, and of this position the extreme left was so far retired from the place as to be in no serious danger at any time, while the right invited attack from the moment of occupation to the close of the operations.

Along the crest of the ridge, posts of considerable strength existed. They were formed either of ancient or modern buildings of good materials and substantial construction. Of these the group on the extreme right, distinguished during the progress of the siege as Hindoo Rao's house, was at once the most important and most exposed. The Mahratta Prince by whom it was built had occupied it for many years, regarding it as his home, and had surrounded the principal house with many inferior offices, all of which were capable of supplying shelter to men and cattle, though not by any means shotproof.

Hindoo Rao having died some time before the mutiny broke out, the place was unoccupied. About 180 yards to the left of Hindoo Rao's house stands the Observatory, an ancient structure suited to the purposes of Hindoo astronomy, built by the Rajpoot astronomer, Rajah Jai Singh. It is of irregular form, dark and ill-ventilated, but as a support to Hindoo Rao's house was found very useful, and was permanently occupied during the siege. About 650 yards further to the left there was an abandoned mosque of the oldest Pathan type in a somewhat ruinous condition, but still affording accommodation for an outpost of respectable strength. This also was suited for a permanent position.

At the distance of nearly a mile from Hindoo Rao's house stands the Flagstaff Tower, a double-storied circular building of Gothic design, which commands an excellent view of the ground lying between the city and the ridge. This building offered sufficient means of shelter to make it useful as a post. Other posts were decided upon from time to time during the siege. On driving the enemy from every point of the ridge on the 8th June, Sir Henry Barnard occupied at once, in strength, the four points just alluded to. He established the headquarters of the Sirmoor Battalion, 2nd Goorkhas, under Major Charles Reid, in Hindoo Rao's house, and there this distinguished corps remained unrelieved from the first day of the siege to the last. Each of the picquets mentioned was supported by two field guns.

The headquarter camp was established on the plains to the westward of the ridge, and occupied the old parade ground of the

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Delhi Cantonment. Immediately in rear of the camp there runs a broad, rapid stream, being a drainage channel from the Nujufghur Jheel to the river Jumna, and along the right flank, at a distance of about a mile, flows the Western Jumna Canal, which, crossing the ridge by a bold cutting through the solid rock executed in the time of the Emperor Shah Jehan, passed through the suburbs of Kissengunge, and enters the city through a culvert in the wall near the Lahore Gate, and traversing the entire breadth of the city, falls into the river Jumna close to the Begumabad Gateway.

Three main lines of road only were immediately connected with the operations before Delhi. The first and most important was the Grand Trunk Road, by which communication was maintained with the Punjab, and along which all reinforcements and supplies were necessarily brought from the country lying to the rear of the force, on the resources of which it was mainly dependent. The second was merely a branch of the first, connecting the camp with the Grand Trunk line at about 1½ miles to the rear.

It formed the old cantonment road to the city, crossing the Nujufghur Drain by a substantial bridge, damaged, but not destroyed, by the enemy during his retreat from the field at Badle-ka-Serai on the 8th June. The third was the line of road connecting Delhi with Rohtuk, Hissar, and other places to the south-westward, along which the enemy drew a considerable portion of his supplies. All the other roads centring at Delhi were completely commanded by the enemy, and it was only by long and precarious détours that any communication was maintained with the districts to the eastward or southward.

The ground around Delhi which was traversed by these canals and roads was, at the time of the siege, a tangled mass of old ruins, dense woodland, rice fields, and swamps of notorious insalubrity. It offered innumerable facilities for occupation by armed men of any degree of discipline, and, indeed, so incompatible were its features with the action of a mass of disciplined troops, that the many combats of which it was the scene were rather trials of skill between small bodies than operation by masses.

At the beginning of the siege the ordnance available for operation consisted of :—

24-pounders	2
18-pounders	9
8-in. howitzers	4
6-in. mortars	6
Total	21
5½-in. Coëhorns	12
Grand total	33

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Many fluctuations in the strength of the force occurred and it is of little practical use attempting to give the precise numbers, but from 500 to 600 sabres, from 2,500 to 3,000 bayonets, and 22 field guns, may be taken as fairly representing the strength during the earlier operations. It is, of course, also extremely difficult to form any accurate estimate of the strength of the enemy, but as some of the most important accessions which he received did not occur until the siege had been for some time in progress, it may be inferred that on the 8th June the garrison of the place did not exceed 8,000 or 9,000 disciplined soldiers, supported by probably about the same number of half-disciplined and wholly undisciplined though armed men. For operations in the open field the sole strength of the garrison was in the trained soldiers, but for the operations in the rugged ground around Delhi, resolute men, familiar with their weapons and profiting by the universal cover everywhere supplied in some house or other, were antagonists whom it was necessary to respect.

In all the important materials and munitions of war the command of the arsenal in Delhi made the resources of the enemy, practically speaking, unlimited. Food was drawn with unrestricted freedom from the whole of the open districts to the east, south, and south-west, and there is no reason to suppose that money was deficient. With all the primary elements of a successful and vigorous defence the enemy was, therefore, abundantly provided.

The permanent posts for the ridge had scarcely been occupied on the 8th June when the enemy, rallied with such reinforcements as the garrison could supply, attacked the position on its whole length, but were immediately driven back on the picquets being reinforced. The most notable point in connection with this attack was the vigorous support it received from the fire of the heavy guns on the Moree and Cashmere Bastions, and the first engineer operations resolved on were directed against the former of these works.

It was determined by the Chief Engineer, in communication with the brigadier commanding the Artillery, to commence on the night of the 8th—9th June two batteries in the neighbourhood of Hindoo Rao's house for two guns each. These were designated Salkeld's and Wilson's Batteries. The armament of each was an 18-pounder and an 8-in. howitzer, and it was supposed that the fire of these four pieces would suffice to subdue, if not to silence, the guns on the Moree and Cashmere Bastions. The range to the Moree Bastion was about 1,500 yards; to the Cashmere Bastion 2,100 yards, and to the Martello Tower, between these two main works, from which occasional support was given to them, about 1,830 yards. Several casualties occurred from round shot. The enemy again attacked on the right flank in great force, but were beaten back with heavy loss.

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By the morning of the 9th June Salkeld's Battery was completed, armed, and opened fire on the Moree Bastion, and by noon of the same day Wilson's Battery was also completed, its howitzer being directed on the Cashmere Bastion, and its 18-pounder on the Martello Tower, where the enemy had placed a gun *en barbette*.

Heavy fire continued uninterruptedly on both sides, and it very soon became apparent that the enemy held a decided superiority. The fire of the four guns in Salkeld's and Wilson's Batteries produced no apparent effect on any of the enemy's works; casualties became serious, and it was clear that if any result was to be produced it was essential that the strength of the batteries on the ridge must be increased. Accordingly, Maunsell's mortar battery* (two mortars) was commenced, and an additional gun portion was added to Salkeld's, Wilson's, and Maunsell's Batteries respectively. While these works were in progress the enemy attacked the right of the position with great vigour, but was repulsed, and on the 11th the whole of the guns, aided by the mortars, opened fire.

The effect of the increased fire from the ridge batteries was so far satisfactory that the enemy's fire was somewhat subdued, but the general result was not encouraging. The enemy still maintained a most effective fire action, and having a vast reserve store of heavy guns, he was more reckless in his method of firing, and took much more out of his guns than the British could venture to do with their scanty supply of pieces of large calibre, the disabling of even one of which was a great misfortune. Hence no real progress had been made.

On the morning of the 12th another resolute attack on the whole position was made by the enemy. It was carried out with unusual determination, and had partial success, a picquet at the Flagstaff post having been cut off, and the two guns there being nearly captured. Ultimately, however, the enemy was driven back at all points with loss. The weakness of the left centre of the position was, however, made so apparent by the partial success of the enemy's first attack that means of strengthening it were essential. Between the ridge and the river in front of the part of the position now under notice lies a low, flat piece of ground traversed by the main road from the cantonment to the city, and on the eastward of this road is Metcalfe's house, a large building which had been sacked and partially destroyed during the outbreak on the 11th and 12th May; about 200 yards to the right of the house there was a substantial masonry building formerly used as a cow-house, while about 400 yards further in advance, or nearer to the place, there was at that time, a large roomy row of stables. The stables and cow-house were occupied on the evening of the 12th June by strong infantry

* Named after Capt. Maunsell, afterwards General Sir Frederick Maunsell, K.C.B., R.E.

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picquets, supported by a troop of cavalry at first, and afterwards by some field guns stationed on a high artificial mound, probably an old brick kiln, near the dwelling house. Considerable variations in details for the tenure of this advanced position subsequently occurred, but throughout the whole of the preliminary operations the stable and cow-house picquets were regularly maintained and proved of great value in protecting the left and left centre of the main line of picquets on the ridge. The distance of the stable picquet from the Water Bastion was about 1,300 yards, and from the centre of the British camp about 2,830 yards, or rather more than 1½ miles.

On the night of the 11th—12th June a new mortar battery, called Perkins' Battery, named after Lieut. Perkins (afterwards General Sir Æneas Perkins, K.C.B., R.E.), was commenced, and during the action of the 12th a working party of 60 Sappers, under Lieut. Geneste,* employed at the time on the batteries, made a very gallant attack on a large body of the enemy, beat them back from the position, and killed a considerable number of them. The casualties among the sappers were three men wounded.

On the 13th the new mortar battery, having been armed during the previous night with two guns, opened fire. The enemy was found to have erected substantial earthen works on the Cashmere and Moree Bastions for the protection of the guns placed there *en barbette*, and the firing during the day was not vigorous. An attack was, however, again made on the right of our position, but was repulsed without difficulty, although supported by a very heavy fire from the whole of the batteries of the place. In the course of this attack the enemy made one very dangerous movement of advancing from Kissengunge with field guns up to the crest of the ridge on the extreme right, and from thence enfilading the entire line of the British batteries. The movement, however, was not persisted in, but it was plain that the enemy had observed a very weak point in the position, and was likely to renew his attempt upon it.

On the night of the 15th—16th June a trench of communication was made between Salkeld's and Wilson's Batteries, revetted inside with stones; the soil being very rocky, the work was one of great difficulty, and proceeded slowly. The enemy was very quiet all night and day, and no attack was made on the position.

It was observed, on the 17th, that the enemy had commenced work on a battery in the suburbs of Pahareepore, and although the mortar practice from the batteries on the ridge was excellent, progress was not stopped. It being of the greatest importance that no permanent lodgment should be permitted on a site where guns

* Lieut. Geneste died very soon after the siege from the result of the exposure he had undergone.

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would take all the ridge batteries in reverse with disastrous effect, Sir Henry Barnard determined on an attack in order to clear the suburb. This duty was effected with characteristic brilliancy by Major Charles Reid* and Major Henry Tombs† with the small columns under their respective commands, supported by four guns. The enemy's battery was captured and entirely destroyed, some loss was inflicted, and the only gun he had brought out from the place was taken.

The great danger of leaving the extreme right of the position unprovided with permanent means of defence now became apparent, and accordingly, on the night of the 17th, a new 3-gun battery, called Johnson's Battery, was traced out on the rocky plateau, about 300 yards to the right of Hindoo Rao's house. Not a spadeful of earth was locally available for the construction of the battery, the soil being bare rock. Material had, therefore, to be brought from the low ground in rear of the ridge, and the progress of the work was accordingly slow. In the morning the enemy kept up such a constant hot fire, that during the remainder of the day progress was virtually suspended. On the night of the 18th—19th it was resumed as vigorously as circumstances permitted, and by the morning of the 19th the parapet of the battery and epaulments was raised to a height of 5 ft. on the left and 6 ft. on the right. The rocky terreplein was raised by aid of the jumper; and platform space for two guns secured. But more could not be done by daylight as the enemy's fire was incessant and heavy, causing some casualties among the working parties. By incessant labour on the part of the sappers and pioneers employed, the battery was at last completed, and mounted with three guns by the 22nd June. But while this work was in progress on the extreme right front of the position, movements of most critical importance were taking place on the right flank and rear. The garrison having been powerfully reinforced about this time by the junction of the Nusseerabad Brigade, a general attack on the British position seems to have been resolved on.

The various outlook posts reported on the afternoon of the 19th that masses of infantry, supported by artillery and cavalry, were steadily defiling through the Lahore and Ajmeer Gates, and gradually extending through all the strong ground in front and on the right flank of the position. About an hour before sunset the high ground immediately in rear of the camp was seen to be occupied by a powerful detachment of the enemy, strongly posted in the gardens and among the ruined walls thickly strewed over the neighbourhood. The crisis was very grave, for the enemy immediately attacked the camp from this position, directing a vigorous fire of artillery upon

* Afterwards General Sir Charles Reid, G.C.B.

† Afterwards Lieut.-General Sir Henry Tombs, K.C.B.

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it, while so general was the threatening aspect of affairs on the front and flanks that only a very feeble fire could be spared to meet this most dangerous movement.

The cavalry and field artillery, however, under Brigadier Hope Grant, after a severe engagement, checked the advance of the enemy for that night, and on the morning of the 20th he was found to have retired from the ground. His retirement was, however, merely momentary, and the position being reoccupied almost before the troops reached camp, it was necessary to repeat the attack. A vigorous fight ensued, ending in the complete rout of the enemy, but with heavy loss in officers and men to the column engaged, which had about one-third of its number killed or wounded out of 600 strong of all arms. The result was, however, so far decisive that no attempt was again made by the enemy to operate on the camp itself from the rear, and the construction of a strong breastwork and battery for two 24-pounders added still further to the security of this part of the position. During the fighting, on the 19th Major Yule, of the 9th Lancers, was killed; Daly (afterwards General Sir Henry Daly, G.C.B.), of the Guides, and Becher (afterwards General Sir Arthur Becher, G.C.B.), Quartermaster-General, were wounded.

On the night of the 23rd a working party, under Capt. Maunsell, accompanied by Lieut. Jones,* of the Engineers, destroyed the only other bridges across the drain in the immediate vicinity of Delhi. Both bridges were completely demolished, and, as it instantly appeared, with excellent results, as the engineer detachment had scarcely left the ground when a strong party of the enemy, with artillery, occupied it in preparation for a general attack on the British position. On the 24th it was found impossible for him, however, to transport his guns across the broad, deep, and rapid stream which had unexpectedly interposed, and it followed that during the vigorous assault of the 24th that the rear of the camp was not threatened as before. The whole of the right of the position was, however, enveloped by the enemy's attack on that day. The suburb of Subsee-Mundee was occupied by him in force, and held with much tenacity. Johnson's Battery was attacked, and from Pahareepore the works near Hindoo Rao's house were taken in flank by a battery of field guns, and some loss inflicted on the troops occupying them.

But the result of the fight was, as it had ever been, the defeat of the enemy at all points, heavy loss being inflicted on him while he retired sullenly into the city. Subsee-Mundee was subsequently held in strength by a regiment of Europeans; a large serai, or travellers' resting place, and a Hindoo temple being prepared for occupation by the troops, and fortified as efficiently as means would

* Killed during the siege.

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permit. Considerable clearances of old ruins and jungle were effected in the vicinity of this post, and its maintenance in support of the advanced battery on the ridge was found to be of much use.

In the many attacks of the enemy on the position, the detachments of artillery with the light guns at Hindoo Rao's house suffered seriously, and cover was accordingly provided for them in a new battery marked "Champain's." * This work was rather of the nature of a breastwork than a regular field battery, the object being to cover the men as much as possible without excessively restricting the sweep of the guns. A similar covering breastwork was provided for the guns at the Mosque, with great labour and difficulty, however, owing to the scarcity of materials. Reports having been received of the intentions of the commander of the garrison to convert the dry ditch of the fort into a wet one by turning into it the waters of the West Jumna Canal, it was determined to cut off the supply at the ancient aqueduct before mentioned. This was done in the first instance by a party of sappers, under Lieut. Champain, who cut through the bank of the canal above the aqueduct, and this turned the whole stream into the Nujufgurh Jheel Drain. Subsequently the partial demolition of the aqueduct was effected by powder, and the passage of the canal permanently interrupted. From the 28th June, accordingly, no water entered the city through the canal channel, but no practical inconvenience was thereby caused to the garrison, as they had complete command of the river Jumna. The fact is noteworthy, as very erroneous conceptions on this, as on many other points, prevailed in England at the time and since.

On the 28th June the Engineer Brigade was strengthened by the arrival of Capt. Alexander Taylor (afterwards General Sir Alexander Taylor, G.C.B., and W. W. Greathed (afterwards Major-General and C.B.), who had up to that time been acting as extra Aide-de-Camp to the Major-General commanding. Capt. Taylor relieved Major Laughton on the 29th.

During the first three weeks of the siege the Delhi Field Force was engaged in repelling the enemy's sorties. There were usually three or four sorties in each week, and some of these were on a very large scale. Large bodies of the rebels (cavalry, artillery, and infantry) could be seen issuing from the Lahore Gate. The general plan of the sorties was to turn our right flank by a large force, and to penetrate into our camp, while smaller numbers advanced under cover of the rocks and bushes for a direct attack on the ridge. In crossing the road leading from the Lahore Gate to the Subsee-Mundee the cavalry and artillery came under the view of our right battery, which poured a heavy fire into the enemy's troops. Those that

* Named after Lieut. Champain, Bengal Engineers (afterwards Colonel Sir John Champain, K.C.M.G., who died in 1887).

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escaped this ordeal apparently swerved to their left, and returned in a disorganized state by the Kabul Gate or by some of the other gates. The repelling of these sorties sometimes occupied several hours. The enemy also made night attacks on our position, and a continual roll of musketry would be kept up for hours. There was a small post among the rocks on the right hand of this position called the Sammy House, and the corpses of the mutineers after one of these attacks were piled in heaps, there being no men available to bury them. How great was the disparity of numbers may be conjectured from the fact that on our arrival on the Delhi Ridge on the 8th June, the Delhi Field Force did not muster more than 3,800 men, and on the day of assault, on the 14th September, were only about 14,000. The number of revolted Sepoys and men in the city varied during the siege from 12,000 to 35,000, in addition to the armed inhabitants. Scarcely a house in the old cantonment was left untouched by the rebels. At this time about 20 native regiments of the Bengal Native Army had mutinied, and accounts were received daily of the mutiny of some regiment.

On the 18th June the rebels were reinforced by the brigade from Nusseerabad, which had joined the mutiny, bringing six guns with them. To celebrate the event, they came out in force, and made an attack on our rear. The contest was most desperate, and the loss on both sides was great. Major Yule, of the 9th Lancers, was killed; Daly of the Guides, and Becher the Quartermaster-General, were wounded.

The Commissioner of Delhi, Sir Theophilus Metcalfe, was in camp at this time. His house, as before mentioned, which had been completely gutted by the rebels, was occupied by our picquets. The mutineers used our bugle calls, and frequently came out to fight wearing their red coats. The buttons on the uniforms of the corpses bore the numbers of the regiments that had mutinied. The work of the artillery in the batteries at this time was most arduous. The most dangerous part was getting into the batteries, as the enemy had constructed a battery on the right of our position, at a place called the Eed Gurh, from which their shot enfiladed the ridge, the shot and shell crashing along the ridge, and striking down anyone who happened to be exposed. One shot fired from this battery entered the doorway of Hindoo Rao's house and killed an officer, Lieut. Wheatley, and eight men of the 2nd Goorkha Regiment, and wounded seven men. After this a large earthen traverse was thrown up in front of the doorway, which prevented the shot from entering the building. The Goorkha Regiment (Sirmoor Battalion) made use of the upper storey of Hindoo Rao's house as a hospital.

At this time news was received of the revolt of the whole of the Province of Oudh and of the Gwalior contingent. The enemy

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received reinforcements almost daily. The strains of the bands of the mutineer regiments could be heard as they marched into the city across the bridge of boats. They played "Cheer, boys, cheer," and other English tunes. However, we also received some welcome reinforcements. A battalion of the 8th King's, a detachment of the 61st Regiment, and two regiments of Sikhs marched into camp at this period.

Lieut.-Colonel Baird Smith took command of the Engineer Brigade on the 3rd July, having travelled about 75 miles the previous day by such aid as he was able to procure, in the hope of being present at an assault of the place planned for the morning of the 3rd. On reaching camp, however, at about 2 a.m., the Chief Engineer learnt that the project, like others of the same kind previously entertained, had been abandoned. He also learnt that the enemy was threatening in force the road from Badle-ka-Serai. On the same day, a strong column, under Major Coke (afterwards Major-General Sir John Coke, K.C.B.), was directed to proceed to Alipore, a point on the line of communication with the Punjab, where the enemy had established himself, having turned the position of the English force by a movement past its right flank on the 3rd of July. Happily, however, he withdrew, abandoning the advantages of his position, after inflicting some loss on the Commissariat post at Alipore.

After carefully inspecting the ground, and becoming acquainted with the details of the position occupied by the force, its capabilities, resources, and future prospects, the Chief Engineer arrived at the following conclusions:—As regarded the plan of defence adopted by the enemy, it was quite clear that two leading ideas pervaded it; first, to drive Sir Henry Barnard from his advanced position on the heights by incessant attacks on the position itself; and secondly, to force him to abandon that position by operations on his line of communications with the Punjab.

Of these two ideas, the enemy held the first with perfect clearness, and acted on it with an unswerving tenacity of purpose, which repeated defeats could scarcely shake. The second was neither apprehended distinctly, appreciated properly, or acted on vigorously by him. It is scarcely necessary to add that this want of discrimination influenced most gravely the fortune of the siege.

The garrison by the beginning of July must have consisted of not less than from 15,000 to 18,000 trained soldiers, and irregulars in even larger numbers. The besieging force numbered of all arms under 5,500 fighting men, Europeans and natives. An enterprising enemy might, therefore, with perfect ease, have maintained one or more strong movable columns, operating constantly on the communication, stopping convoys, harassing small detachments, disturbing the whole tract of country whence supplies were obtained,

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and finally, in all human probability, compelling the General to raise the siege from the impossibility of procuring subsistence for his army in a position so utterly insecure. Instead, however, of obstinate and continuous operations of this class, the enemy was satisfied to make feeble efforts, never sustained for any considerable time, and easily warded off by corresponding movements of columns detached from the force. It was necessary, however, at the time now under notice, to take precautions against both forms of attack. The vast numerical superiority of the enemy converted the position of Sir Henry Barnard's force from the very first into that of a besieged, instead of a besieging, army.

Commencing on the 8th June, the attacks by the garrison on all points of the ground held outside the walls were incessant. The casualties of the force day by day were most serious. Many of its bravest and best officers had been killed or severely wounded; the daily average of casualties among the soldiers averaged from 30 to 40, and on occasions of vigorous combats the loss rose from 100 to 150. It was scarcely possible to resist the conviction that the army was steadily and surely being used up by the ordinary process of the siege, and it seemed as though a simple calculation would show that at such a rate of waste of life the status of a force numerically so feeble could not be sustained for long. To shorten the siege, or limit the waste of life, were the urgent necessities of the position. The former could be effected only in one of two ways, the first by regular operations against the place, or second by an assault *de vive force*. The insufficiency of artillery and engineer *matériel* for even the most limited formal operation made the first plan wholly impracticable. An official return supplied to the Chief Engineer on the 4th July showed that in the Artillery Park the entire ordnance supplies of the force were:—

Round shot, 24-pounders	150
,, ,, 18-pounders	628
Shells, common, 8-in.	2,016
,, spherical, 8-in.	192
,, common, 24-pounders	240
,, spherical, 24-pounders	43
,, 5½-in., 24-pounders	3,200

These details tell their own tale, and require no emphasis.

The whole supply of ordnance powder for 17 siege pieces in position was no more than 11,600 lbs., barely sufficient for one day's active firing, and even the musketry powder had sunk to 12,900 lbs. The Engineer Park was quite as insufficiently supplied for even the briefest formal operations. It is questionable whether batteries could have been maintained, even if their first construction had been practicable, as revetting materials were in extremely small

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numbers. Hence there was no hesitation whatever in abandoning all idea of operations of this class.

The second course, viz., an assault *de vive force*, was plainly a most desperate expedient in the actual condition of the force at the moment. It could only have been justified by assurances of the highest authority that the critical emergency of political circumstances had been such that all risks must be run to achieve a success.

The possibilities of success were sufficient to have warranted the General in making an attack even so desperate as that on Delhi would have been. The Chief Engineer came to this conclusion at the time, and adhered to it until circumstances to be explained hereafter had completely changed.

Assuming, however, that an assault involving such undeniable risks might be deferred, systematic provision for reducing the waste of life on the ridge was of the most urgent necessity, and though the means were small, both in men and material, it was absolutely necessary that they should be used and multiplied if the position were to be maintained for even a day.

On the morning of the 5th July, Sir Henry Barnard received the Chief Engineer at a confidential interview, which lasted about three hours.

The General in command explained to the Chief Engineer in most unreserved terms his views of the position of the force, and at first, especially, was evidently and most justly impressed with the deepest anxiety for its safety, and felt acutely the heavy weight of personal responsibility that must attach to his decisions. The general conclusions to which the Chief Engineer had come, as briefly detailed above, were duly submitted to the General, and were fully discussed. Reserving his final decision, however, at the moment, he appointed a second meeting at noon of the same day, when he expected to be prepared to give definite orders.

There were no external signs of fatal sickness at that time apparent about Sir H. Barnard. A worn and anxious expression of face, with a certain heaviness and dimness of eye, not at all natural to him, were the only signs of suffering that attracted the Chief Engineer's notice. And even these passed away as the discussion advanced, till the general cheerfulness of bearing under all difficulties, which did so much to win for him the warm affection of the whole force he commanded, resumed its usual glow, and the Chief Engineer left Sir Henry Barnard at the close of the interview as resolute for the present, and as hopeful for the future as ever. Scarcely an hour or two passed before the General was stricken with an attack of cholera, and on the Chief Engineer's return to headquarters at about 11 a.m. he was met by the medical attendants with the assurance that Sir Henry could now see no one, and that

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the worst was to be feared as to the issue of the disease. The anticipation was realized the same afternoon, and it was with the truest sorrow that the army learnt of the loss it had sustained in the premature death of a chief admired by all for his undaunted courage, his unwearying activity, his single-hearted devotion to duty, and beloved by all for his thoughtful care, courteous bearing, generous appreciation of the efforts of his officers and men, and the general spirit he diffused around him. No one can make the conduct of Sir Henry Barnard during that terrible month of June, 1857, a careful study without feeling that few soldiers have ever faced sterner perils with a stouter heart, and none have surpassed him in devotion to the Crown, or in the resolute discharge of duty under physical and moral conditions, so exhausting that life sunk beneath their pressure. On the death of Sir Henry Barnard, Major-General Reed, C.B., assumed the command of the Delhi Field Force.

(*To be continued*).

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THE ABOR EXPEDITION SURVEY DETACHMENT, 1911–12, *AND OF THE ABOR EXPLORATION SURVEY DETACHMENT,* 1912–13.

By CAPT. O. H. B. TRENCHARD, R.E.

Reproduced by the kind permission of COLONEL SIR S. G. BURRARD, K.C.S.I., F.R.S., R.E., *Surveyor-General of India, from the "Records of the Survey of India," Vol. IV.,* 1914.

SURVEY operations extending over two seasons, were carried out in the basin of the Dihāng River by a detachment with the Abor Expeditionary Force in 1911–12 and by a detachment with the Abor Exploration Party in 1912–13. This report deals with the operations of both detachments.

Dihāng is the commonly accepted name of that portion of the Tsan-po River on the Indian side of the main range of the Assam Himālayas, *i.e.*, from the eastern end of the gorge through the range to its junction in the plains of Upper Assam with the Dibāng and Luhit Rivers; these three rivers forming the Brahmaputra.

Strictly speaking the river is only known locally as the Dihāng by the Mīris who inhabit small villages on its banks near the confluence of the three rivers; throughout the whole of its course in Abor country it is almost invariably known as the Siang; while in Pemakoi-chen the inhabitants use the Tibetan name of Tsan (Po or Chu = river).

It may be noted that all the local names by which this river is known are merely adjectival; translated into English they all mean "The Big River."

To avoid confusion the name Tsan-po will only be used in this report to denote the river in Tibet proper; the name Dihāng will be used to denote the whole of the remaining portion of the river on the Indian side of the main Himālayan Range.

After the Tsan-po leaves Tibet, by cutting its way through the Himālayas from west to east, about longitude 95°, in a gorge by what must be from all accounts of considerable length and so utterly precipitous as to make it impossible for any man or animal to traverse it, it enters the country of Pemakoi-chen, through which it flows roughly speaking in a south-westerly direction. Pemakoi-chen may be described shortly as the portion of the valley of the Dihāng between latitude 29° (south of which it is bordered by the Abor country) and latitude 30° (north of which the country of Pomed is situated). The valley is a narrow one, of an average width of

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30-40 miles, being bounded on the right bank of the river by the well-defined main Himālayan Range and on the left bank by the equally well defined and regular watershed between the Dihāng and Dibāng Rivers.

The northern limits of Pemakoi-chen are at present somewhat vague; our knowledge of them is confined to the information collected by the Political Officer in charge of the Abor Exploration Party from the inhabitants of the Southern Pemakoiba villages which were visited by the party in 1912–13. The surveys now being executed in this area by Capt. Morshead, R.E., should however define the boundary between Pemakoi-chen and Pomed.

The only important tributary received by the Dihāng in its course through Pemakoi-chen appears to be the Chimdru Chu, draining a considerable side valley of the same name, which joins the left bank of the Dihāng just north of the village of Khapu in latitude 29° 30′. Several large mountain torrents drain the eastern slopes of the main range and join the right bank of the Dihāng during its course through Pemakoi-chen, but none of them are large enough to be termed tributary rivers. The largest of them is the Sirapateng (Sigong) River which forms the southern boundary of Pemakoi-chen (as claimed by the Pemakoibas, although there are three Abor villages north of this river) on the right bank. A slightly larger stream called the Yang Sang Chu forms the boundary between Pemakoi-chen and Abor country on the left bank of the Dihāng, which it joins about 10 miles north-east of the Sirapateng Confluence.

South and west of these two boundary rivers the whole basin of the Dihāng is inhabited by the various tribes commonly called Abor.

From the Sirapateng Confluence the Dihāng flows nearly south-east to latitude 28° 30′; thence in a more southerly direction to the Siom Confluence about latitude 28° 15′, whence it again trends east and south-east until it debouches at Pasighat (latitude 28° 4′) from the Abor Hills into the plains on the north bank of the Brahmaputra River.

After leaving Pemakoi-chen the basin of the Dihāng widens out considerably, two large valleys of the Siom and Yamne being situated on either side of the main valley. Both these important tributaries join the Dihāng before it debouches into the plains. The Siom is by far the larger of the two; rising in the main range of the Himālayas in latitude 29° it flows to the west of and roughly parallel to the Dihāng as far south as latitude 28° 12′ whence it turns east for about 20 miles before joining the Dihāng near the village of Yekshing.

The Yamne is a considerable river which rises in the small range (jutting out west about latitude 28° 45′ from the main Dihāng-Dibāng Watershed) that forms the divide between the valley of the Yang Sang Chu and the valley of the Yamne.

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It flows to the east of the Dihāng, to which it is for the most part roughly parallel, and joins it below the trade post of Rotung in about latitude 28° 10′.

The Dihāng Basin is thus bounded on the west by the well-defined watershed between the valley of the Siom and that of the Subansirī River to the west; on the east it is bounded by the range which divides Pemakoi-chen and the Yamne Valley from the basin of the Dibāng River to its east.

The range which forms the Dihāng-Subansirī Watershed takes off from the main Himālayan Range in latitude 28° 50′ and longitude 94° 0′, the junction being marked by a clump of three snow peaks all over 16,500 ft. in height, and runs in a south-easterly direction down to about latitude 28° 0′ where it merges into the outer range.

The range which forms the Dihāng-Dibāng Watershed has not been surveyed yet north of latitude 29° 30′; it is not certain therefore whether it actually joins the main Himālayan Range. Between latitudes 29° and 29° 30′ the direction of this range is from south-west to north-east; south of latitude 29° it runs almost due south down to latitude 28° 15′ where it also merges into the outer range.

This outer range is a remarkable feature which runs for many miles parallel to the north bank of the Brahmaputra and at a distance of 20–40 miles from it. It averages between 3,000 to 6,000 ft. in height, and slopes very steeply to the plains of the Brahmaputra. Forming the southern boundary of the Dihāng River basin proper, it completely shuts off all view of this basin from the Brahmaputra Valley. The Dihāng has cut its way through this range at Pasighat before issuing into the plains of the Brahmaputra.

The main range of the Assam Himālayas forms the northern boundary of the Dihāng Basin from longitude 94° on the west to the big gorge in longitude 95°. North and east of the gorge the direction of the range has not yet been defined, and very little is known about the valley of the Po Tsang Chu which drains Potodh, Pomed and Poyul and which constitutes the extreme north-eastern portion of the Dihāng Basin.

Pemakoi-chen is inhabited by a race of people very similar to their neighbours in Tibet proper on the other side of the main range.

They are undoubtedly emigrants from Tibet, but appear to have been settled in the Dihāng Valley for a considerable time, as I understand their language is a very distinct variation of Tibetan spoken in the Kongbu District of Tibet.

Pemakoi-chen appears to be a separate district of the Po country, to the headman of which, called the Po Khanem living at Shawa in Pomed, taxes are remitted by officials who are appointed by him and reside in Pemakoi-chen for the purpose. It is doubtful whether the Po Khanem is a Tibetan official or not; I understand that all

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the latest evidence points to the fact of the Po country being entirely independent of Tibet.

Pemakoi-chen is certainly not connected officially with the neighbouring Kongbu district of Tibet in any way, although a good deal of trade passes between the two districts over the Himālayas and the Pemakoibas seem to understand and talk the Kongbu dialect well.

The Pemakoibas are sturdy, well-built people and much cleaner than either the Tibetans or the Abors, between whom they act as middlemen in the matter of trade. They have attained (or perhaps not yet lost) a fair degree of civilization, and utterly despise the Abors whom they call Lobas. The Abors call them Menbas (the Abor name for a pure Tibetan being Mimat).

The Pemakoibas dress in Tibetan fashion modified for the heat of the Dihāng Valley, and their religion is the same as that of Tibet. As a rule the Gom-pa (place of worship) is the only masonry building in each village ; the houses being built of boards with well-made shingle roofs and raised off the ground on timber posts or masonry pillars. All the carpentering shows a considerable degree of skill.

The Dihāng Valley does not lend itself to easy cultivation, but the Pemakoibas terrace and irrigate their rice fields wherever possible, and even their jhūmed fields on steep hillsides are properly ploughed and all the paddy transplanted dry. They are open, cheerful and friendly people ; but could probably put up as good a fight as the Tibetans if necessary, being armed with bows and arrows, the long straight sword, and a certain number of matchlocks and ancient pistols.

Tibetan coinage is current in Pemakoi-chen and seems a fairly well-understood medium of exchange. No difficulty was therefore experienced in persuading the Pemakoibas to accept Indian rupees, at the rate of three of their own *tankas* to a rupee. Eight- and four-anna pieces did not seem as popular as the rupee, but were accepted. Assamese silk cloths are the most popular articles of gift.

The Abors are very dissimilar from their northern neighbours, although presumably of the same Mongoloid extraction. The irruption of their ancestors from the highlands of Tibet into the Dihāng Valley must have taken place several centuries before that of the Pemakoibas, and in the meantime they have certainly lost all traces of any slight civilization they may have possessed originally.

The chief reason for their present state of savagery appears to be the peculiar political (if such a term can be used) organization which prevails all over the Abor country. The only political unit is the village ; there is no real tribal organization, although the country is divided into several more or less defined sections which, for lack of a better definition, might be termed tribal areas.

In some of these tribal areas there is one dominating village which by its wealth or numbers of fighting men can impose its orders on

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the other villages of the same tribal area, but in other areas there are two or more big villages of equal importance which seem far more disposed to quarrel with each other than to combine against the villages of another tribal area. In fact the only features which appear to distinguish the various tribal areas as such, are the separate dialects of each and the intermarriage in the different sects of all the villages in each area.

The more important tribal areas may be roughly defined as follows :—

(1). The Simongs, so called by the name of the most important village of the group, occupy the left bank of the Dihāng from the Yang Sang Chu (Pemakoi-chen boundary) in the north down to about latitude 28° 30′ and stretch over into the north-west corner of the Yamne Valley. This is perhaps the most important group, though not the largest numerically, in the whole Abor country.

(2). South of the Simongs, on the left bank of the Dihāng and stretching across the Dihāng-Yamne Divide into the Yamne Valley, are the Pangis, a small tribe which seems closely allied to the Simongs and undoubtedly has to take orders from the head village of Simong.

(3). On the right bank of the Dihāng, immediately south of Pemakoi-chen, is a group of seven villages, the two most important of which are Janbo and Bomo, the most southerly. This group does not appear to have a tribal name.

(4). South of Bomo on the right bank of the Dihāng are the Karkos, a small group of four villages, of which Karko is the most important.

(5). South of the Karkos are the Minyongs, who inhabit a small portion of the Siom Valley, a few villages on the left bank of the Dihāng south and west of the Pangis, all the right bank of the Dihāng (including the Shimang Valley) south of latitude 28° 30′ right over the outer range into the foothills just above the north bank of the Brahmaputra.

This Minyong tribe is the largest numerically, but there are a number of large and powerful villages in it which do not pull together. Of these *Riga* is the largest village and *Dosing* (at the mouth of the Shimang Valley) the most powerful.

(6). The Yamne Valley is mainly inhabited by Padams, who also thrust a wedge into the Dihāng Valley between the Simongs and Pangis and stretch across the outer range into the foothills between the Dihāng and Sesseri Rivers. This is a large tribe and the head village of Damro is the largest in the whole Abor country.

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(7). The Boris occupy the head-waters of the Siom Valley down to about latitude 28° 36′. As all the Bori villages have not yet been visited it is impossible to say which is the most important.

(8). The remainder of the Siom Valley and the valley of the Simen River, the only river of any size on the south of the outer range between the Dihāng and Subansirī Rivers, are occupied by a number of cognate subdivisions which in the bulk are known as Galongs. The largest village in this area is Kombong, in the south-east corner of the Siom Valley.

In all these areas each village is entirely self-contained and independent except in so far as it has to take orders from some neighbouring and more powerful village. As the only method of cultivation known to the Abors is by jhūming, it follows that each village requires a large area of land to enable it to exist; hence the villages are all at a considerable distance from one another, and there seems to be little communication between the villages. A *jhūm* (not an Abor word, but one commonly used all over Assam) is a clearing in the forest used for cultivation. As the only iron instrument the Abor possesses is a dao, this forest clearing is a matter of infinite labour.

The crops raised are rice, maize, and millet; the last principally for brewing apong, a mild and unpleasant intoxicant of which the Abors drink inordinate quantities.

Not more than two or three crops can be raised in successive years from the same soil, as the principle of manuring is unknown; so patches of forest have to be cleared in rotation, trees and jungle being allowed to grow on each clearing again after it passes out of cultivation until its turn comes round again.

Industry in all matters agricultural seems to be the Abor's one redeeming feature. In other respects he possesses all the usual traits and vices of the savage. His fighting qualities are not very conspicuous, but his intense hatred and suspiciousness of strangers combined with a full measure of treachery will make it unsafe to neglect military precautions when travelling through the Abor country until it has been brought under proper political control.

The village has already been mentioned as the sole political unit of the Abor country. A village may have one or more Gams (headmen), but these dignitaries do not seem to have any real power other than that they may acquire by wealth, force of character, or a large following of fighting men in the village. An Abor village is one of the most democratic institutions in the world, and exhibits all the effects of unrestrained democracy. Every matter, however trifling, is referred to the Kebang (village council) which all men and most boys seem at liberty to attend and at which they all talk

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at length. If the Gam or Gams be strong enough they can sway the Kebang; otherwise they are merely the mouthpieces of the temporary majority in the Kebang.

This system of self-government does not tend to simplify the dealings of outsiders with the Abors.

These are further complicated by an extraordinary system of octroi which prevails, under which every village takes its toll of all the merchandise which passes through its territory. Trade does not prosper under these conditions, and is limited to the bare necessities such as iron, cloth, and salt.

The natural hatred of a foreigner imbued in every Abor is not lessened by the feeling that he can only be coming into the country to deprive the Abor of his middleman's profits.

The Abor does not possess nor does he understand a coinage; all trade is by barter. Now that a British trade post has been opened in the lower part of the country the value of money may gradually come to be understood; for many years however its acceptance can only be guaranteed by a sufficient backing of military force.

Salt, red blankets, cloths (ordinary and silk), buttons, needles, cheap ornaments, knives, pipes, etc., are all useful and appreciated by the Abor as gifts or in payment for labour and the few commodities he is able or willing to dispose of. It may be noted however that the Abor dislikes nothing so intensely as cooly work even for liberal payment. It is very difficult to persuade an Abor village to provide transport; even if one can get it at all only the women and children will turn out as a rule.

Opium is at present practically unknown, but the habit will soon be introduced no doubt when intercommunication between the hills and plains is an established fact. Rum is useful for entering into relations with an Abor village.

Abors wear little clothing, the male dress sometimes consists of a loin cloth and a loose cloth or woollen coat is worn in the cold weather. The women all wear a curious girdle of metal discs, called a *boyop*, from babyhood until the first child is born; their clothing consists of a short petticoat and a shoulder wrap. The women do most of the field work and are excellent carriers.

In assuming his war dress the Abor adds a rain coat (made of sago palm) to his scanty attire; and his equipment consists of bow and arrows, long Tibetan sword, dao, cane helmet and a large ruksack woven out of bamboo shavings.

The Dihāng Basin is for the most part extremely mountainous; Dihāng itself and all its tributaries running in deep, narrow, and most tortuous gorges which the rivers have cut in the course of ages. Wherever by some change in the geological formation the valleys widen out bold precipitous spurs run down steeply from the crest of the ranges bordering each valley to river level. The only

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comparatively flat and level spot in the whole basin is contained in about 20 square miles of plateau in the south-east corner of the Siom Valley on which Kombong Village is situated.

An excessive rainfall causes the whole of this precipitous mountain region to be covered with dense forest and semi-tropical vegetation right up to permanent snow level, which is estimated to be about 14,000 ft. Large trees of many varieties, but all excessively difficult to cut, flourish on steep slopes (which only the Serow can traverse) right up to 10,000 ft., interlaced with all kinds of impenetrable undergrowth, among which the rhododendron, small bamboo and ringalls growing in thick clumps, and prickly cane seem to preponderate.

A kind of cypress covers the hillsides and tops in the Abor country above 10,000 ft.; in the higher latitudes of Pemakoi-chen this tree is to be found as low as 6,000 ft. The pine is only met with in the Tsan-po Valley where it flourishes exceedingly.

A feature of the country is the width and roundness of most of the actual hilltops. Seeing that they are all as heavily timbered and covered with as dense an undergrowth as the valley bottoms the labour of clearing them for triangulation is immense. It is not always possible to select only the hilltops above permanent snow level as stations of observation; a triangulator must therefore be accompanied by a strong detachment of men provided with and skilled in the use of cutting instruments, if his work is not to be seriously delayed. The plane-tabler can fortunately make shift as a rule with the innumerable jhüm clearings on the hillsides; but it is imperative to provide him with good English axes, both of the felling and hand variety, and a number of flexible chain saws which are easy to carry, to enable him to undertake a limited amount of clearing whenever it is unavoidable. Abors very seldom jhüm the actual hilltops of even the lowest hills, as they seem to reserve them for game sanctuaries.

Apart from other considerations it is evident that, in a country like this only good hill climbers used to forest work and skilled in the use of a cutting instrument should be recruited as khalasis. The pure Nepalese is undoubtedly the best man for this sort of work, but any Gurkhali is more useful than men of other races. If possible young ex-sepoys should be recruited through the agency of some Gurkha Regiment or Police Battalion, as they are naturally more reliable in an emergency and understand the necessity and reason of discipline better than a Gurkha who has not been in the ranks.

Communications in the Abor country invariably and in Pemakoi-chen generally are extremely bad.

Even if the Abor habit of exclusiveness, mentioned in the preceding paragraph, did not exist to militate against an expansion of

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trade and the consequent necessity for better communications, the extraordinary natural difficulties of the country would make it nearly impossible for him to improve the tracks much with the materials at his disposal.

As it is both Abors and Pemakoibas are uncommonly good bridge builders; not only are all the smaller streams provided with good stout log bridges, but very ingenious tubular cane bridges (and in Pemakoi-chen wooden cantilever ones as well) are built over all the larger streams. In the early part of 1913 the Dihāng was found to be bridged in this way at four places in the Abor country and in no less than seven places in that portion of Pemakoi-chen visited.

These tubular cane bridges do not of course permit the passage of animals nor will they stand constant heavy traffic, such as a daily convoy of coolies. For this purpose however they can easily be strengthened by the insertion of two 1 or 1½-in. wire ropes to carry an additional footway of bamboo slats.

No rope bridges of the Mishmi pattern were actually seen, though one is reported to exist over the Tsan-po near Gyala.

In all other respects the tracks are excessively difficult and present many obstacles to a laden cooly. With the exception of 32 miles of mule road built from Pasighat to the Yembung River near Kebang during the Abor Expedition in 1911–12, a road which one monsoon season sufficed to obliterate in most places, the only tracks in the Dihāng Basin are footpaths. From the nature of the country and climate the building and maintenance of the mule roads, which are so urgently required to open the country out, will be a very difficult and expensive undertaking.

The present footpaths invariably go straight up and down hill, the art of grading a road is not understood, or at any rate is despised.

To enable the villages to collect their octroi, all tracks must lead through the different villages; alternative tracks by an easier route are not permitted. The bad places on these switchback paths are often improved as far as possible by galleries and ladders of notched logs; but it may be taken as a general rule that survey parties and their escorts cannot be maintained in the Abor country for any length of time unless they are accompanied by strong detachments of Sappers & Miners to improve the lines of communication by which the convoys of coolies must travel.

Until the country is taken over and properly administered large escorts will be necessary, the rationing of which entails the employment of immense numbers of imported coolies. There are no supplies in the Abor country available for sale or export; under the present system of cultivation the produce barely suffices to support the local population and has to be eked out at certain periods of the year with food stuff prepared from the fruit of the jack tree and

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even from the fibrous core of a kind of palm tree pounded into pulp. There are no sheep or goats in most parts of the Dihāng Basin; village pigs can sometimes be bought to feed certain classes of Gurkhas and other pig-eating races, but the Englishman and Musalmān have to go without meat as a rule seeing that poultry is scarce and the tame Mithan practically unobtainable.

Fruit does not abound in this country; there are immense quantities of wild plantain trees (the leaves of which are very useful for hunting purposes) but only small patches of the edible variety are to be found in the vicinity of villages. Oranges seem to thrive in the lower parts of the Abor country into which they have probably been introduced from the plains. A few peaches are grown in Pemakoi-chen. Kinds of wild crab apple, wild plum, and lemons grow in certain localities, but only the Abor could eat the two former.

A peculiar feature about the Dihāng River worth noting is the comparatively easy gradient at which it flows throughout its entire course in Pemakoi-chen and the Abor country.

The river has been surveyed accurately up to the Chimdru Chu Confluence in latitude 29° 30′, that is to within a distance from the probable position of the big gorge through the Himālayas of not more than 30 to 40 miles (estimated along the bends of the river).

At this point the height of the river is only 2,750 ft. above mean sea level.

At the Sirapateng Confluence in latitude 28° 53′, about 85 miles further down, the height is 1,270 ft.

In this section therefore the gradient is 1 in 300.

At the Shimang Confluence in latitude 28° 19′, about 80 miles below the Sirapateng Confluence, the height is 700 ft., giving a gradient in this section of 1 in 750.

At Pasighat, where the river debouches into the plains about 45 miles below the Shimang Confluence, the height is 494 ft., the gradient being 1 in 1,200; while 30 miles lower down at the junction of the Dihāng and Dibāng Rivers the height is 400 ft., the gradient being 1 in 1,760.

This gives an average gradient in a total length of some 240 miles of 1 in 530.

Seeing that the height of the Tsan-po at Gyala cannot be less than 9,000 ft. above mean sea level, it is interesting to speculate on the nature of its course in the intervening and still unsurveyed portion of 40–50 miles between Gyala and the Chimdru Chu Confluence, in which it drops 6,250 ft. This drop may be fairly regular, but it seems more probable that it must occur mainly within the limits of the gorge itself.

Unfortunately the Dihāng River is not navigable for any considerable distance above Pasighat owing to innumerable rapids

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throughout its entire course. The Abors utilize rafts made of bamboos to cross this and other rivers; we have found Wheatley and Polyansky bag rafts more satisfactory for the same purpose. Berthon boats are very useful in the preliminaries of getting the cable and traveller for the raft across big rivers, but are difficult to carry about over the bad tracks on account of their weight and bulk.

Crossing the Dihāng and its large tributaries on rafts is only practicable between the end of October and the beginning of April. During the other months of the year the river is in high flood from melting snows and sudden storms. In the narrow gorge below the trade post at Rotung for instance the measured difference between low water and high flood level is 78 ft. At the same place the width of the water channel at low water is 160 yards; during high floods it is nearly 300 yards.

No really satisfactory methods could be devised for measuring the volume of water in the Dihāng River. Lieut. Huddleston, R.E., executed a series of measurements, as accurately as possible under the circumstances, at Pasighat in December, 1912, and has computed the volume at 80,000 cubic feet per second. The volume determined by the late Capt. Harman, R.E., at mean low level of the year in 1878 at a spot a few miles below Pasighat was 55,500 cubic feet per second (*vide* Report on the Explorations of A.K. dated 1884). As however Capt. Harman omitted to measure the volume of water in one of the channels into which the Dihāng divides on entering the plains, Lieut. Huddleston's figure of 80,000 cubic feet per second at mean low level of the year is undoubtedly the more correct.

A marked and unpleasant characteristic of the Dihāng Basin is the extremely heavy rainfall it receives. The main valley appears to act like a funnel up which pours every moisture-laden wind from the Bay of Bengal during most of the year to precipitate all over the valley on striking the Himālayas at its top.

Even when it is not actually raining the higher hills are nearly always enveloped in heavy clouds; in fact during every single month of the year it is never possible to observe to the higher Himālayan peaks after 9 a.m.

Not having been in the country during the month of September I am not in a position to give a definite opinion as to the wettest portion of the year, but I am inclined to think the months of March, April and May are the worst in this respect.

Curiously enough the three monsoon months of June, July and August in 1913 were infinitely finer and drier than the three preceding months, but I believe the summer of 1913 was an abnormal one all over Upper Assam.

It is now a well-established fact that there are only three

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months, *i.e.*, from 15th October to 15th January, during which any operations, particularly survey work, can be carried out with any certainty of comparatively fine weather. It has been proved that it is not impossible to carry on survey work in this country throughout the year, but people who have to work or even merely live in the country from the middle of January to the middle of October must be prepared to undergo considerable hardships and suffer a good deal of sickness.

The following table shows the number of days on which plane-tabling either could or could not be carried out during the whole of the season 1912–13.

Month.	Fine Days.	Wet Days.	Total.
November, 1912	7	—	7
December ,, ...	28	3	31
January, 1913	25	6	31
February, ,, ...	18	10	28
March, ,, ...	12	19	31
April, ,, ...	18	12	30
May, ,, ...	8	23	31
June, ,, ...	16	14	30
July, ,, ...	21	10	31
August, ,, ...	12	2	14
TOTAL ..	165	99	264

A similar meteorological record was kept by all survey officers during the season 1911–12 and submitted to the Director-General of Observatories. No copy is however available for this report. Very similar conditions prevailed during the season of 1911–12 as in that of 1912–13. Torrential rain was experienced during the latter end of September and the first week of October, 1911. A period of comparatively fine weather then followed from 9th October, 1911, until about 20th January, 1912. From that date until the detachment left Kobo on 9th April, 1912, very bad weather was experienced, few days being fine or clear enough to permit theodolite observations.

The first consideration therefore in a climate like this is to devise some efficient protection against the rain for all the members and equipment of a detachment, with due regard to the limitations of weight and bulk imposed by coolie transport. Tents (except for the base) are out of the question, efficient huts locally known as *bāshas* can only be made in standing camps ; for temporary bivouacs however it is always possible to run up rough frameworks of timber or bamboo and to roof them with waterproof sheets and tarpaulins.

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These should invariably be of stout Willesden canvas or some other rot-proof material, and even the best rot-proof material will not stand the effect of the Dihāng Valley climate for a longer period than six months if used continuously.

It has been found that an officer's or surveyor's squad of khalasis requires one big (12 ft. × 8 ft). paulin for the roof of its *bāsha*. The best patterns are those supplied by the Ordnance Department or Supply and Transport Corps.

If each khalasi is supplied in addition with one rot-proof sheet (7 ft. × 4¾ ft.), as issued by the Supply and Transport Corps to all troops and followers, in which to roll up his bedding by day and which serves as a ground sheet by night; and also with one light mackintosh sheet (5 ft. × 5 ft.) which he carries on his person by day for use as a mackintosh, it has been found possible to keep the men comparatively dry and comfortable at night while bivouacking on the march.

The light mackintosh sheets mentioned above which the khalasis carry on the person are also useful in sheltering the plane-tabler when working in light drizzles of rain or in dripping jungles.

For officers and surveyors the light (10-lb.) *tente d'abri* made by the Elgin Mills Company of green rot-proof canvas, size 8 ft. × 7 ft., forms an excellent shelter tied on the underside of a rough framework, on top of which plantain leaves, small branches of trees with the leaves on, etc., can be quickly piled to break the force of the rain.

Theodolite boxes must be provided with stout waterproof covers; the plane-table in its ordinary cover must also be wrapped in an extra sheet (6 ft. × 6 ft.) of Willesden canvas to protect it from the rain.

Intense cold is never experienced on the lower hills and in the valleys of the Dihāng Basin; in fact all members of the Abor Expeditionary Force carried on with remarkably little sickness during the cold weather months of 1911–12 on practically a summer scale of clothing, although several parties had to bivouac above or near the snow line for considerable periods on many occasions.

As a rule however the khalasis should be provided with the winter scale of clothing from the start, seeing that Survey Detachments must work above snow level as far as possible in order to be above tree level.

Arrangements should be made if possible to ensure the escorts and coolies who accompany Survey Detachments above snow level being also provided with winter clothing and good boots. Boots have to be renewed every two months in this region.

If all details of equipment, etc., are carefully worked out on the above lines before the detachment is actually mobilized, it has been found possible to keep officers and men fit for weeks on end in the

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wettest weather on a very limited scale of transport. The following is the minimum scale of baggage for any period over and above a week :—

	Coolies.
One officer's and his servants' personal baggage and cooking pots (Mess extra according to time)	2
One khalasi	½
Tarpaulin, cooking pots, etc., for one squad of khalasis	1

The coolie's ordinary net load is 60 lbs. This minimum scale only provides the minimum amount of comfort of course ; but it is given to show what has been and can be done to limit the baggage of a detachment without unduly imperilling its health.

Owing to the excessive humidity of the Dihāng Basin it is impossible for men to reach and work at the same heights as in the drier climate of the Western Himālayas. 16,000 ft. is probably the extreme limit of height to which plane-table or theodolite can be carried, but, as men who are quite capable of working at this height on the Western Frontier feel great distress at lower altitudes in this region, it is essential for every member of a Survey Detachment to undergo a careful medical examination before the start of operations.

From the latter end of February survey work in this basin is much impeded during any long spell of dry weather by the haze of jhūm fires.

The obnoxious *dam dim* fly puts in an appearance about the same time. Leeches of course abound at most periods of the year. On account of both these pests a large supply of permanganate of potash should be carried and the men should be made to bathe their feet and legs therein nightly whenever leeches are very prevalent. Unattended bites, sores, and cuts usually put far more men on the sick list than fever and other diseases.

Great heat is usually experienced in all the valleys from July to September and at this period the sandflies are unbearable. They seem to cause a peculiar kind of malarial fever, which medical science has not yet been able, I believe, to define exactly.

Quinine must of course be issued in prophylactic doses to everyone from start to close of operations in this region.

Our geographical knowledge of the Dihāng River Basin and of the eastern reaches of the Tsan-po in Tibet, prior to the surveys now under report, was very scanty.

From time to time between 1858 and 1911 several small military expeditions had been despatched up the Dihāng from Assam to punish the Abors living just behind the outer range for incursions into British territory. None of these expeditions were accompanied by trained surveyors and none of them managed to penetrate very

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far into the Dihāng Basin, so their contributions to the geography of the country were practically *nil.*

The last and most successful of these expeditions advanced up the Yamne Valley in 1894 to operate against the Padams and managed to reach the vicinity of the most important village, Damro, before retiring back to Assam. There was no trained surveyor with the expedition and the survey work accomplished was practically *nil.*

In 1909 the Assistant Political Officer of Sadiyā (the late Mr. Noel Williamson) made a journey up the right bank of the Dihāng from Pasighat to Kebang Village. He was accompanied by Surveyor Partab Singh, who executed a very accurate survey on the ¼-in. scale of the country traversed, about 300 square miles in extent, although only 11 days in all were spent on both the outward and return journeys.

No surveyor accompanied Mr. Williamson on his last journey up the Dihāng in the spring of 1911, when he was massacred by Abors in Komsing Village.

Much valuable and, as it turns out, extremely reliable information about the Dihāng Basin was however collected by the Explorer Kinthup during the course of his travel between 1880 and 1884.

In order to determine, if possible, the unknown course of the Tsan-po in Eastern Tibet and beyond, the late Capt. Harman, R.E., then in charge of the Assam Survey Party, sent a man known as G.M.N. up to Tibet (*viâ* Darjeeling and Lhāsa) in 1878 to follow down the course of the Tsan-po.

G.M.N. was a Lāma of the Pemiongchi Monastery in Sikkim whom Capt. Harman had engaged as a Munshi to teach him Tibetan. Finding him very intelligent Capt. Harman offered him service as an explorer, which G.M.N. eagerly accepted, and instructed him in the methods of route surveying before despatching him on this journey.

Kinthup, a native of Sikkim, accompanied G.M.N. as an Assistant, and they managed to reach the village of Gyala at the western end of the big gorge through the Himālayas before returning to India by the same route they had gone out.

On G.M.N.'s return to India in 1879 his work was plotted and adjusted by Capt. Harman; the course of the Tsan-po between Chetang and Gyala, as depicted ever since on the maps of the department, depends therefore mainly on this compilation of the surveys and report of G.M.N.

Full details are given in the "General Report on the Operations of the Survey of India" of 1878–79.

G.M.N. had been told at Gyala that the Tsan-po, after passing through the gorge of the Himālayas east of that village, flowed eventually into British territory.

As this report fitted in with the theory (first advanced in 1788

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by James Rennell in his "Memoir to the Map of Hindoostan") that the Tsan-po and Dihāng were one and the same river, Capt. Harman engaged a Chinese Lāma in 1880 to continue G.M.N.'s explorations of the Tsan-po. Kinthup was again employed to accompany this Chinese Lāma as an Assistant.

They reached Tibet by way of Darjeeling, visited Lhāsa, and then proceeded down the Tsan-po to Gyala where they crossed to the left bank and continued their journey to Pomed, crossing the mountains by the Dhemu La from Tibet. On reaching a place called Tong-juk Dzong in May, 1881, the Chinese Lāma sold Kinthup as a slave to the Jongpen and decamped with the proceeds. All his instruments, note books, etc., were taken away from Kinthup, who had to work for the Jongpen until March, 1882, when he managed to make his escape into Pemakoi-chen.

He eventually reached the monastery of Marpung on the right bank of the Dihāng, and was kindly received by the head Lāma whom he served (in repayment of the ransom to his pursuers from Tong-juk Dzong) for practically the whole of the time he remained in this region. During this period he managed on several occasions to obtain leave of absence from Marpung on pretence of visiting holy places in different parts of the country, and made several extended journeys of exploration.

The last of these journeys he made was down the Dihāng into Abor country, in the hope of being able to return to India that way.

He managed to reach the vicinity of Damro, but was not allowed to proceed further and had to retrace his footsteps to Pemakoi-chen, from where he returned to Lhāsa and finally to India, which he reached in November, 1884, after four years' absence.

Owing probably to the death of Capt. Harman, which had taken place in the meanwhile, Kinthup's story was not taken down and translated until two years after his return, when Colonel Tanner compiled a sketch map of the Dihāng Basin from Kinthup's narrative.

This map has constituted the sole geographical record of the Dihāng Basin from that day to now.

Kinthup was not a trained explorer, all his instruments, note books, etc., were stolen from him early in his journey, and he had therefore to rely entirely on his memory in giving his account of travels extending over four years and a large area of country. The sketch map prepared by Colonel Tanner was not compiled from information based on any kind of route survey, but from a narrative account only.

These facts are presumably unknown to or else ignored by people who criticize either the map or Kinthup's narrative.

Kinthup's story was corroborated in many particulars by a previous narrative (given to Explorer U.G. of the Survey of India)

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of a Mongolian Lāma called Serap Gyatsho who had lived and travelled in Pomed and Pemakoi-chen between 1856–68.

Furthermore the important fact, established by Kinthup, of the identity of the Tsan-po and Dihāng was indirectly proved by the explorations made by Surveyor A.K. in Eastern Tibet between 1879 and 1882, who found that the Tsan-po did not continue to flow north or east beyond Gyala and did not join the systems of the Irrawaddy, Salween, Mekong or Yangtse-Kiang Rivers.

In face of all this evidence few geographers have since doubted the fact of the Tsan-po and Dihāng being one river; it has only remained for scientific survey to furnish the final proof.

The complete reports, narrative accounts, etc., of the above-mentioned explorers are given in the following publications:—

(1). Report on the Explorations of Lāma Serap Gyatsho, Explorer K.P., Lāma U.G., Explorers R.N. and P.A. in Sikkim, Bhutān and Tibet (Trigonometrical Branch Office, 1889).

(2). Report on the Explorations in Great Tibet and Mongolia made by A.K. in 1879–82 (Trigonometrical Branch Office, 1884).

Further references to these explorations will also be found in the "General Reports on the Operations of the Survey of India" for 1881–82, 1882–83, 1886–87, 1887–88, 1888–89.

After the murder of Mr. Williamson and his party by Minyong Abors in March, 1911, the Government of India decided, with the sanction of the Secretary of State, to despatch a military expedition up the Dihāng in the cold weather of 1911–12 with the primary object of punishing the Minyongs and of finally establishing our military superiority in the estimation of the Abors. An important but secondary object of the expedition was the survey of as much of the country as possible. The Surveyor-General was accordingly requested to detail a Survey Detachment to accompany the Abor Expeditionary Force. He was also asked to detail two other detachments to accompany friendly missions which it was also decided to send at the same time to co-operate in the general programme of survey operations on the North-East Frontier (of Assam); one to visit the tribes living in the Subansirī Valley; and the other to visit the Mishmis of the Dibāng and Luhit Valleys.

In addition to the main requirements of survey, as stated above, the Government of India also wished an exploring party from the Abor Expeditionary Force to visit the falls (mentioned by Kinthup) of the Tsan-po River in the vicinity of Gyala and incidentally to settle the question of the identity of the Tsan-po and Brahmaputra Rivers.

Orders were issued by the Surveyor-General early in September,

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1911, for the formation of the Abor Expedition Survey Detachment (Capt. O. H. B. Trenchard, R.E., in charge; Lieut. G. F. T. Oakes, R.E.; Lieut. J. A. Field, R.E. (from 4th February, 1912); Mr. Sher Jang, K.B.; Surveyor Hamid Gul; Surveyor Abdul Majid (served as computer); Computer Narayan Singh; Surveyor Abdur Rahim (from 4th February, 1912); Surveyor Shankar Singh (from 4th February, 1912); 34 khalasis; 23 khalasis (from 4th February, 1912). Mobilization was completed in Calcutta by 23rd September, 1911; on which date the detachment embarked on the s.s. *Sherani* for the river journey to Kobo, the base of operations, a small clearing on the north bank of the Brahmaputra, a few miles west of the Dihāng Confluence.

The detachment arrived at Kobo, where the troops composing the force were then assembling, on the 8th October, 1911.

Active military operations against the Minyong Abors were in progress from about the 20th October, 1911, until the end of December, 1911. During this period very little survey work was accomplished owing to the exigencies of the military situation. While the main body of the army was advancing up the right bank of the Dihāng River, a small column on the west flank operated against the Minyongs established on the south side of the outer range.

Capt. Trenchard and Mr. Sher Jang followed the main body up the Dihāng; Lieut. Oakes and Surveyor Hamid Gul accompanied the flank column until the end of November, 1911, when the operations of this column came to an end, the troops and Survey Detachment returning to the valley of the Dihāng.

The total out-turn of detailed survey on the ¼-in. scale up to the end of December, 1911, amounted to about 200 square miles. Plane-tabling was rendered possible by the number of great trigonometrical intersected points of the Assam Valley series of triangulation, completed in 1877–78, which cover the whole area traversed up to about latitude 28° 15′.

As the outer range completely shuts out all view from the south of the mountain ranges of the Dihāng Basin behind it, no points in the area, north of latitude 28° 15′, had been fixed by triangulation from the old series, which follows the course of the Brahmaputra River. Lieut. Oakes managed to clear Torne Hill on the outer range and observe therefrom in November, 1911; other than this no triangulation could be carried out up to end of December, 1911.

The exploration parties working in the northern portions of the Dihāng Basin from about the beginning of January, 1912, until the end of March, 1912, when all operations closed, had therefore to enter an area devoid of triangulated points and one in which the dense vegetation, covering all the hills up to permanent snow level, precluded all idea of a hasty reconnaissance triangulation on the march.

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On the 27th December, 1911, a small exploration party, commanded by Mr. A. Bentinck, I.C.S., Assistant Political Officer to the General Officer Commanding, left the headquarter camp near the Yembung River and the village of Kebang to penetrate as far up the Dihāng River as possible and to cultivate friendly political relations with all the villages on the line of march.

Capt. Trenchard and Mr. Sher Jang accompanied this party. Singing, a small village of the Simong Group on the left bank of the Dihāng nearly opposite the Sirapateng (Sigong) River Confluence, was reached on the 31st January, 1912. The party was unable to proceed any further up the Dihāng River and retired slowly down the valley, reaching the headquarter camp near Kebang again on 28th March, 1912.

During the advance of this party the detailed survey carried out by Mr. Sher Jang had to depend entirely on a plane-table triangulation made from fixings on or near the path along the bottom of the valley. Although the most northerly point intersected by Mr. Sher Jang is more than 60 miles distant from the two triangulated points (of the old Great Trigonometrical Series) from which this plane-table triangulation was started, there is no plottable error between the positions of any points intersected on the plane-table and afterwards computed from the later triangulation.

Two hilltops, near the villages of Simong and Geku on the right bank of the Dihāng, were cleared by working parties of the 1st Battalion 8th Gurkha Rifles, and transport coolies on the line of communication of the party during its advance.

As no skilled labour or felling tools were available this proved a task of great magnitude.

During the retirement of the party down the valley Capt. Trenchard was able to make theodolite observations from both these cleared hills. At the beginning of March, 1912, Capt. Trenchard crossed the Dihāng and spent 20 days on the top of Arte Hill, the highest point of the Dihāng-Shimang River Divide, clearing the hilltop and waiting for fine weather before the necessary theodolite observations could be made.

At the same time Mr. Sher Jang crossed the Shimang Valley and the hills which divide it from the Siom Valley to the west, and managed to make a reconnaissance survey of a small area in the latter valley before returning to the rest of the party at Riga in the Dihāng Valley. Apart from this and a small area in the vicinity of its confluence with the Dihāng reconnoitred by two other parties, the Siom Valley was neither visited nor mapped during the expedition.

Capt. Trenchard and Mr. Sher Jang finally reached the headquarter camp near Kebang on 28th March, 1912.

Another small party, under the command of Col. D. C. Macintyre and accompanied by Lieut. Oakes and Surveyor Hamid Gul left

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Rotung on the 26th December, 1911, to explore the Yamne Valley. Having crossed to the left bank of the Dihāng the party marched down it to Porging Village near the Yamne Confluence, from there advanced up the right bank of the Yamne as far as Sibbum Village, and then crossed the divide into the Dihāng Valley, reaching Geku Village on 1st January, 1912. After halting in this village for two days the party returned by the same route to Rotung where it arrived on the 7th January, 1912.

On the 20th January, 1912, the same party again left the main line of communications on the right bank of the Dihāng, which it crossed a few miles above Pasighat. From here the party followed the route taken by the expedition of 1894 up the left bank of the Yamne and reached Damro Village, where a halt of five days was made to give Lieut. Oakes an opportunity of making theodolite observations from Kallang, a hill in the vicinity. It rained continuously throughout the three days Lieut. Oakes spent in bivouac on top of Kallang, and no triangulation could be carried out. The party then retired down the Yamne and returned to Rotung on the 10th February, 1912.

On the 4th February, 1912, the detachment was reinforced unexpectedly by the arrival at Kobo of Lieut. Field, R.E., and three surveyors. Owing to lack of transport, escorts and other reasons it was found impossible to utilize the services of the three surveyors as fully as could have been wished during the remaining two months; one of them extended by a small amount the surveys (during November, 1911) of Lieut. Oakes and Hamid Gul on the southern slopes of the outer range, another carried out a 1-in. plane-table traverse survey of the mule road from Kobo to the Yembung River, while the third was practically unemployed.

Lieut. Field was usefully employed in carrying out a good minor series of triangulation from two base stations of the Assam Valley (G.T.) series over the outer range and terminating near the latitude of Kebang. He observed at five out of the six stations of this series, Lieut. Oakes completing the observations at the sixth station. Bad weather unfortunately prevented a satisfactory junction of Capt. Trenchard's triangulation with this series.

During February, 1912, a small party accompanied by Surveyor Abdul Majid made a hasty reconnaissance of the lower reaches of the Siom and Shimang Rivers. Practically the whole of this area was recovered by Lieut. Oakes and Surveyor Hamid Gul in March, 1912, who left the headquarter camp near Kebang on 4th March with a small party to explore the Shimang Valley and to extend the triangulation from a station at its head.

The survey of the Shimang Valley was completed, but bad weather and lack of time and transport made it impossible either for Lieut. Oakes to make any theodolite observations or for the party to cross

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over into the Siom Valley and return down it to the headquarter camp as had been arranged. The party therefore retired down the Shimang Valley and reached the headquarter camp on 23rd March, 1912.

On the 28th March Mr. Bentinck's Dihāng party also reached this camp, and the next day the united detachment accompanied the headquarter staff on the final stage of the retirement to Kobo which was reached at the beginning of April, 1912.

The week which elapsed before demobilization orders were received was spent at Kobo in drawing the originals from which the provisional map of the surveys executed was published later.

The whole detachment left Kobo on the 9th April, 1912, by river steamer. On arrival in Calcutta the khalasis were immediately paid off and sent to their homes, the surveyors returned to their original parties or proceeded on leave, and the detachment was completely demobilized by the end of April, 1912.

The geographical results achieved by the expedition were disappointingly small.

Owing to the inability of the exploring party to penetrate further up the Dihāng Valley than latitude 28° 55′, neither of the geographical objects of the expedition—the survey of a suitable frontier line and the establishment of the identity of the Tsan-po and Dihāng as one and the same river—was accomplished.

As it was found impossible to survey the Siom Valley no connection was made with the work of the Mīri Mission to the west; similarly, the inability of the Mishmi Mission to the east to survey the Sesseri and Dibāng Valleys resulted in no connection being made with their work.

A good minor series of triangulation based on the old Assam Valley (G.T.) series was however carried over the outer range into the Dihāng Basin, as a result of which (and the subsidiary triangulation carried out by Capt. Trenchard) 45 new points were intersected in a previously untriangulated area, 11 of them being situated in a continuous range of high snowy mountains bounding the valley to the north and west which we now know is a portion of the main Himālayan Range. An interesting fact disclosed by this triangulation was the existence of a peak (Namcha Barwa) in this range well over 25,000 ft. in height. Further details of the work completed by the Abor Expedition Survey Detachment are given in other paragraphs of this report.

The detachment suffered very little sickness throughout the expedition. One officer spent the first week at Kobo in hospital with fever, and one of the computers had an attack of jaundice in November, 1911, which necessitated his removal to the base hospital at Dibrugarh for a short period. Only one of the khalasis suffered severely from fever.

(*To be continued*).

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REVIEW.

PAGES D'HISTOIRE, 1914.

(Librairie Militaire Berger-Levrault, Paris: 5, Rue des Beaux-Arts).

NEW numbers of the *Pages d'Histoire*, 1914 series, in continuation of those already reviewed in the *R.E. Journal*, have recently been published by the Librairie Militaire, Berger-Levrault. The 16th, 17th and 19th numbers are in continuation of the 14th number of the series, and deal with mentions in despatches, promotions, and awards of the Legion of Honour and the Médaille Militaire. The 16th number covers the period 15th—26th October; the 17th number the period 28th October —1st November; and the 19th number the period 6th—10th November, 1914.

The 18th number contains the official communiqués and telegrams issued to the Provincial Authorities by the French Government during the month of November; these communiqués are in continuation of those which appear in the 6th, 7th, 8th and 12th numbers of the series.

The 20th number is a reproduction of the Belgian Grey Book, and contains a copy of the Belgian diplomatic correspondence arising out of the ultimatum sent by Austria to Servia in July last. This number contains 79 separate despatches, with their appendices, the first of them being dated 24th July and the last 29th August. They are arranged in groups under the dates borne by them, each group being preceded by a short summary of its contents. The correspondence forms an important addition to the volume of evidence already published in the British White Paper and the French Yellow Book in relation to the part played by Germany during the crisis of July last. The despatches show that at a very early date after the development of the crisis the Belgian Government notified the several Powers which had, under the Treaty of April, 1839, undertaken to protect Belgium's neutrality, the firm resolve of the Belgian people strictly to carry out all the obligations imposed upon a Neutral State. So that there should be no mistake as to the intentions of the Belgian Government its diplomatic representatives abroad were instructed on the 29th July that the Belgian Army was immediately being placed on the footing known as "paix renforcée," and the distinction between this state of military preparedness and a mobilization was briefly explained, in order that the real military situation in Belgium might be made clear should enquiries on the subject be addressed to the Belgian embassies. The original German text of the first ultimatum handed to the Belgian Foreign Minister by the German Ambassador at Brussels on the 2nd August, as well as that of the second German ultimatum presented through the Dutch Foreign Office on the 10th August after Liège had fallen, are reproduced in

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this number, together with the French translations of the same with notes thereon. Among the other documents appearing in this number are copies of the declaration of Dutch neutrality, and the decree issued at The Hague on the 6th August last for regulating the navigation of the Scheldt during the existence of hostilities.

Under the regulations contained in this decree, the use of the Dutch portion of the river is prohibited to vessels of war of all kinds belonging to the belligerent Powers, as well as to their subjects liable for military service. The last of the series of despatches in this number are dated from Antwerp, and deal with the text of a telegram, dated Berlin, 31st July, from Sir E. Goschen to Sir E. Grey, published in the British White Paper. In this telegram it was stated that, according to the German Government, certain hostile acts had been committed by Belgium; it being alleged that a consignment of corn for Germany had been placed under an embargo. In the correspondence on this point, it is made abundantly clear that the Belgium Customs authorities at Antwerp had merely misinterpreted the terms of a decree forbidding the export of cereals from Belgium, and had detained for a short time only a consignment of corn for Germany which was being transhipped in the Scheldt; the consignment being in reality in transit was not affected under the terms of the decree. As soon as the matter was brought to the notice of the Belgian Foreign Office, the German consignment of corn was at once released. But the Berlin authorities decided to make the most out of the incident. Probably it was thought, at the time, that any excuse, however flimsy its basis, was good enough for the purpose of justifying the repudiation by Germany of the pledges given by Prussia in April, 1839.

The 21st number contains a copy of the diplomatic correspondence published in the Russian Orange Book. The despatches, of which there are 79—the first dated 23rd July and the last 6th August, 1914 (new style)—are arranged in groups under the dates borne by them, as in the case of the despatches contained in the preceding number of the series, each group being likewise preceded by a short summary of its contents. The despatches contained in this number tell the same story as that published in the British White Paper, French Yellow Book, and the Belgian Grey Book, and complete the damning evidence in relation to the nefarious design of Germany to make use of Austro-Hungary as a cat's-paw in her great scheme to acquire an overlordship over the nations of the world. A *résumé* of the crisis prepared by the Russian Foreign Office on the 2nd August, and the copy of a despatch of the same date, sent by the Russian Foreign Minister to the Russian diplomatic representatives at the European Courts, placing the responsibility for the rupture of friendly relations on Germany are published in this number, which concludes with the notification, dated 6th August, 1914, handed by the Austro-Hungarian ambassador at St. Petersburg to the Russian Foreign Minister, in which it is declared that in view of the commencement of hostilities by Russia against Germany, Austro-Hungary likewise considers herself at war with the former as from 6 p.m., 6th August, 1914.

W. A. J. O'MEARA, *Major, late R.E.*

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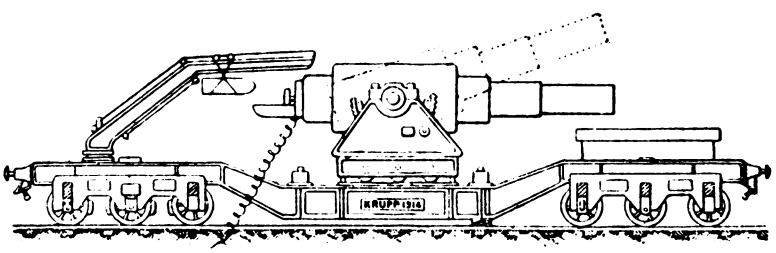
NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

December, 1914.

THE SIEGE MORTAR, KRUPP, 42 C.M.

In the pages of the *Génie Civil* (November, 1914) there is published an interesting article on Austrian and German heavy artillery, which contains a description of the 42-c.m. mortar. While, however, the author declares that he is not able to guarantee absolutely the exactness of the information, we may report the following translation of the extract regarding this mysterious mortar :—Much attention has been drawn during the present war to the mortar of 42 c.m. used by the Germans,and in regard to which great secrecy was kept up to the moment of its entry into action at Liège, Namur, Maubeuge, and Antwerp. A mortar of this calibre has the power of throwing a projectile 1·50 m. in length, capable of containing an enormous weight of explosive, and consequently producing destructive effects that can easily be imagined. It is only necessary to consider that the shells from a mortar of 28 c.m. and of smaller calibre are able to put out of service the works of strong fortified places like those above mentioned. It has not yet been proved how much of the destruction of the forts of Belgium and Maubeuge was due to the 42-c.m. mortars. In any case it would seem certain that the 42-c.m. mortar bears an important part in modern warfare, and that the firm of Krupp have constructed a limited number of such mortars, from four to eight, or perhaps more. The accompanying



drawing represents approximately the scheme of this famous siege mortar, drawn from sketches furnished by persons who have been able to see it at the railway station at Cologne. The carriage with the mortar placed upon it has a special platform. Each of the front and hinder portions of the platform are supported upon a truck with three pairs of wheels. The whole can be placed upon the lines of railway, specially prepared. The central part of the platform (on which the

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carriage is placed) is lower than the front and back parts. The carriage below is joined to a circular base provided with small wheels which allow for the rotation of the carriage on a diameter of about 2·80 metres. The rotation of the carriage for aiming, and the movements of the mortar in elevation and in depression, are obtained by means of special hydraulic transmission. The mortar is fired by electricity. The gunners having arranged the conducting wires, retire to a distance from the piece. The shells are charged with an explosive having picric acid for its base, which when bursting produce an enormous quantity of deleterious gas. It is reported that during the fire practice near Cologne some rabbits were found asphyxiated at a distance of more than 100 m. At an angle of 45 degrees the range of fire reaches 14 k.m. On arrival of the mortar at the battery the platform is lowered to the ground by means of hydraulic cranes and completely unshackled from the two small carriages on wheels. At one extremity of the platform there is fixed a small revolving crane which serves to take the projectiles from the wagons and to place them in the mortar, then charged for firing. The siege train comprises, in addition to the carriage, a locomotive and tender, a wagon carrying ammunition, a wagon for the gunners, and one containing a motor for petrol which serves to put in action the different parts of the accessories, as for example, the hydraulic transmission for the parts of the mechanism connected with aiming, one dynamo, etc. The piece with its carriage and platform weighs from 100 to 110 tons, the entire train about 300 tons. The carriage is about 18 m. in length. Material, such as that described above, evidently cannot be placed on a railway in good condition, and would be quite unable to traverse military bridges constructed in the field to substitute those that may have been destroyed. It would be sufficient to destroy in good time, in a sufficient radius, the railways near the fortified places to impede the mortar of 42 c.m. from being placed in a battery at a convenient distance.

FRANCE.

Aeroplane Armed with Mitrailleuse.—The following is extracted from the *Kriegstechnische Zeitschrift* :—

At the last aeronautical salon held in Paris there were exhibited several aeroplanes of different kinds armed with the Hotchkiss mitrailleuse. Only one presented a satisfactory solution of the system of placing the propeller in the rear part of the machine in such a manner that the mitrailleuse could be used with an extensive vision for fire. But in this type of aeroplane the gun had to be managed by the pilot himself, since the seat of the observer was placed behind that of the pilot.

This naturally is very inconvenient. Signor Loiseau, it would now seem, has solved the problem in a satisfactory manner with a special apparatus placing the propeller in the rear of the machine. The mitrailleuse is fixed on a pivot so as to allow of its being fired in any position, and is placed in front of the pilot. A steel shield, 4 m.m. in thickness, protects the firer from the front and the sides, and behind he also has protection from a metal balustrade. The position of the firer certainly is not perfectly secure, and it also somewhat limits the view of the pilot.

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Notwithstanding these drawbacks, this type of aeroplane is better than those armed with the Hotchkiss mitrailleuse. It should be noted that the pilot is able to look below through two small apertures, between the wings of the machine and its protected body, one on the right and the other on the left.

The experiments with the Loiseau apparatus were commenced at Villacoublay, near Paris, on the 10th February, 1914. The trials were not very satisfactory; partly owing to an insufficient number of exercises. However, the trials showed practically the possibility of good results with the mitrailleuse.

January, 1915.

FORTIFICATION IN ACTUAL WAR.

In the pages of *Jahrbücher für die Deutsche Armee und Marine* of last November Colonel v. Voelki commences the publication of a series of articles on modern war, with some general considerations of the part taken by fortification in the western sector up to the present time.

The great war—writes the Author—has now lasted three months, and after so many great events it is not yet positively known of the forces employed by the belligerents, nor of their plans of campaign or of the reasons that inspired them. The future only can give the necessary elements for judgment. However, it is now possible to examine the facts so far known as regards the functions exercised by fortifications, and to deduce certain considerations. At the commencement of the campaign there took place the unexpected fall of Liège after an assault *de vive force* of one of the forts, and immediately followed by the capture of the city after a hand-to-hand strife, this again being at once followed by the destruction of the other forts, to which the mortars of 42 c.m. powerfully contributed. According to the report of General Leman, the town was captured on the 7th August; from the 11th to the 14th the principal fort, Loucin, was bombarded by artillery of 10, 15, 21-c.m. calibre; on the 14th there also came into action the 42-c.m. mortar; and on the evening of the 15th August the fort was destroyed.

Namur did not fall so promptly to the German attack, because its defenders had time to throw obstacles in the way of the enemy's advance by all kinds of demolitions, and especially because they succeeded in employing a considerable number of mobile troops in the defence of the place. The success of the attack on the fortress Maubeuge which before might be considered capable of most resistance was also complete.

But all these places, the Author observes, were wanting in a true and complete ceinture; and, they also, had no provision for the defence of the intervals between the forts; there being none at Liège, and only relatively in good condition at Maubeuge. Now these circumstances can essentially explain the rapid conquest of these strong places; with a rapid procedure of attack facilitated by the most powerful means of offence, not forgetting the *élan* and the extraordinary violence with which the assaults were conducted. The attack *de vive force* of a fort, even under favourable conditions, is always an action requiring rare heroism, which, generally, now as in the past, it is impossible to calculate

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upon. In any case, it may be stated that the competent experts have never approved of the suppression of the ceinture around the nucleus of a strong fort, and there is no one that does not recognize the very great importance of the organization of the intervals between the external forts, without which a long resistance by these forts is not possible. Modern war has demonstrated the inevitable lot of a place violently attacked, when not provided with a ceinture, and perhaps not well organized with regard to the action that should be devolved from the defence of the intervals between the forts. The essential characteristics of the war of to-day, continues the Author, are the unlimited increase in the numbers, and the variety of the means of offence. The active participation of masses has a special importance at the second period of the actual war, which commenced in France on the 22nd August up to the time that the victorious German advance arrested at Nancy, and consequently transformed in the middle of September, after the retirement of the right wing, into a real war of position on a front of Belfort, by Epinal, Verdun, Rheims, to Amiens. What was the cause that brought about this state of affairs? Evidently it was the force of the circumstances by which, little by little, the forces of the defenders came to nearly equal those of the attack. And this happened when the defenders were deprived of all disposable means, most essentially among these the rapid transport of troops and material, fortifications, and means for the defence of the country, and then the defenders animated by a great energy, indeed a true fanaticism, which in order to create obstacles to the attack did not even stop at a voluntary devastation of its own country.

The part represented, in this period, by the French fortifications was very important, especially by those on the eastern front. It is undeniable that the system of defence of the French territory up to now has efficiently performed its duty, and that the French have known with real talent the value fortification is indisputable. The war has given them the best occasions for obtaining wide advantages from preparation for territorial defence made long ago, and with the greatest care.

The Author contends that for the rest no one has ever doubted the value of fortifications as depôts, rallying points, bases of operation, places of refuge for the defending troops; and this value is so much the greater as the fortifications are of a more vast area. This is clearly proved in modern war, at Belfort, Epinal, Toul, and Verdun. It is true that the range of action of a fortress is not very extensive, and may be considered as limited to the circle of the zone ranged over by the artillery, but it is indisputable that the works of fortification are most valuable barriers, and it is only after their destruction that the assailants can consider themselves victors.

The fortresses on the eastern front are of the greatest interest for actual war. Paris and Antwerp both considered and organized as central redoubts for extreme defence, Antwerp as being near the sea and Paris being of such an extensive area that it could not be completely surrounded. Antwerp has fallen in front of an unexpected, strong, impetuous attack. But of this siege the final acts are not yet closed

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and there may yet be much to say. This however is certain, that Antwerp was not equal to its duty, which was to retain possession of an important position until the entry into action of the troops of the defence. But it may be noted that the conditions of this strong place only permitted a limited resistance.

Paris, up to now, has only exercised an indirect action; but, altogether, its influence on the place and conduct of the war has been of the greatest value. And this, not for one only of the belligerents. Paris, as an entrenched camp is a factor of capital importance, either for the assailants or for the defenders. It offers the best conditions for defence in the greatest proportions not only by its position but by its most important disposable means among which are those of rapid transport.

Colonel v. Voelki remarks on the difficulty of placing the action of the fortresses in perfect accord with that of the troops, and on the dangers that are likely to occur from their united action. The power of the troops consists essentially in their freedom of movement, and if this freedom should be lost or worse if it should be renounced they become for the fortress a source of ruin. The activity of the troops, and their rapid dispositions, more than their number, give protection to a fortress. The troops should be most free in their actions and not tied by any fixed laws to the fortifications. The latter represent only points of resistance and security against possible attacks.

The actual war of position, in the western sector, is, according to the Author, a phenomenon of the conditions of the times. We cannot ignore the physiological conditions of the armies which have a tendency to react against the extraordinary tension caused by the exhausting combats which have taken place up to now. Nor is it possible not to take count of the great force of resistance of the defence. In the face of the immense forces employed in the present war, the theories and fine phrases vanish and their place is taken by the war of positions; and calmness and tenacity become the essential factors of success. But is it possible to reconcile the idea of the advance with the decided tendency to remain closed up in the trenches, and to seek a secure protection from the fortifications? Up to the present time neither one nor the other of the belligerents has succeeded in finding a good solution. At first view, there seems no clearness of ideas, and the facts seem unexplainable; positions fall which were thought to be impregnable and others resist that were absolutely valueless. The old truth seems to be verified, that it is not so much the passive resistance as the *élan* and aggressive spirit of the troops that are in every case the more valuable elements of the defence.

E. T. THACKERAY.

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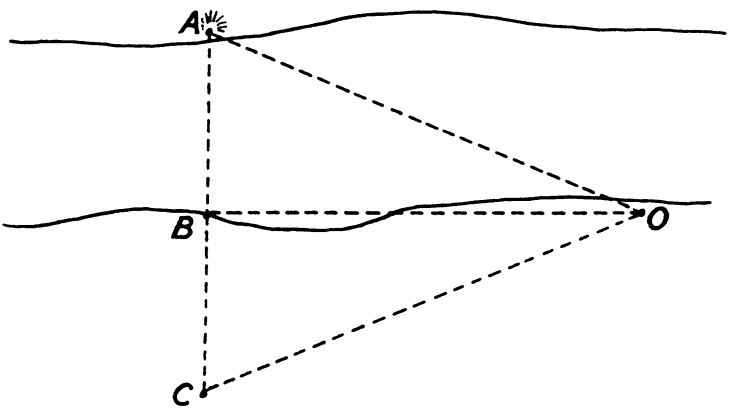
A RAPID METHOD OF MEASURING GAPS UP TO 75 FEET WITHOUT APPARATUS OF ANY SORT.

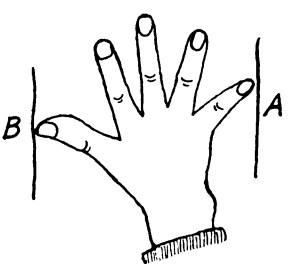
By 2ND LIEUT. R. C. CHRISTIE, 80TH (FIELD) CO., R.E.

CHOOSE an object A on the far bank (a tuft of grass will often be enough), place a stick opposite it at B. Place a man C in line with AB, so that BC is about equal to the width of the river.



The observer O places himself at a convenient distance, so that the angle ABO=90°. To do this it is quite sufficient to estimate when A and C are equally distant from him.

From O the exact position of C is obtained by spanning with the hand.



Holding the hand at arm's length—back towards one—spread the fingers until the thumb just touches B, and the little finger, A (see *Fig.*).

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Now move the arm towards BC, and move C until BC spans the same as AB.

Then BC=AB.

Using the above method I have measured gaps up to 75 ft. quickly, and with an error never exceeding 3 per cent. Beyond that width the advantage of speed and simplicity becomes hampered by the size of the triangle OBC.

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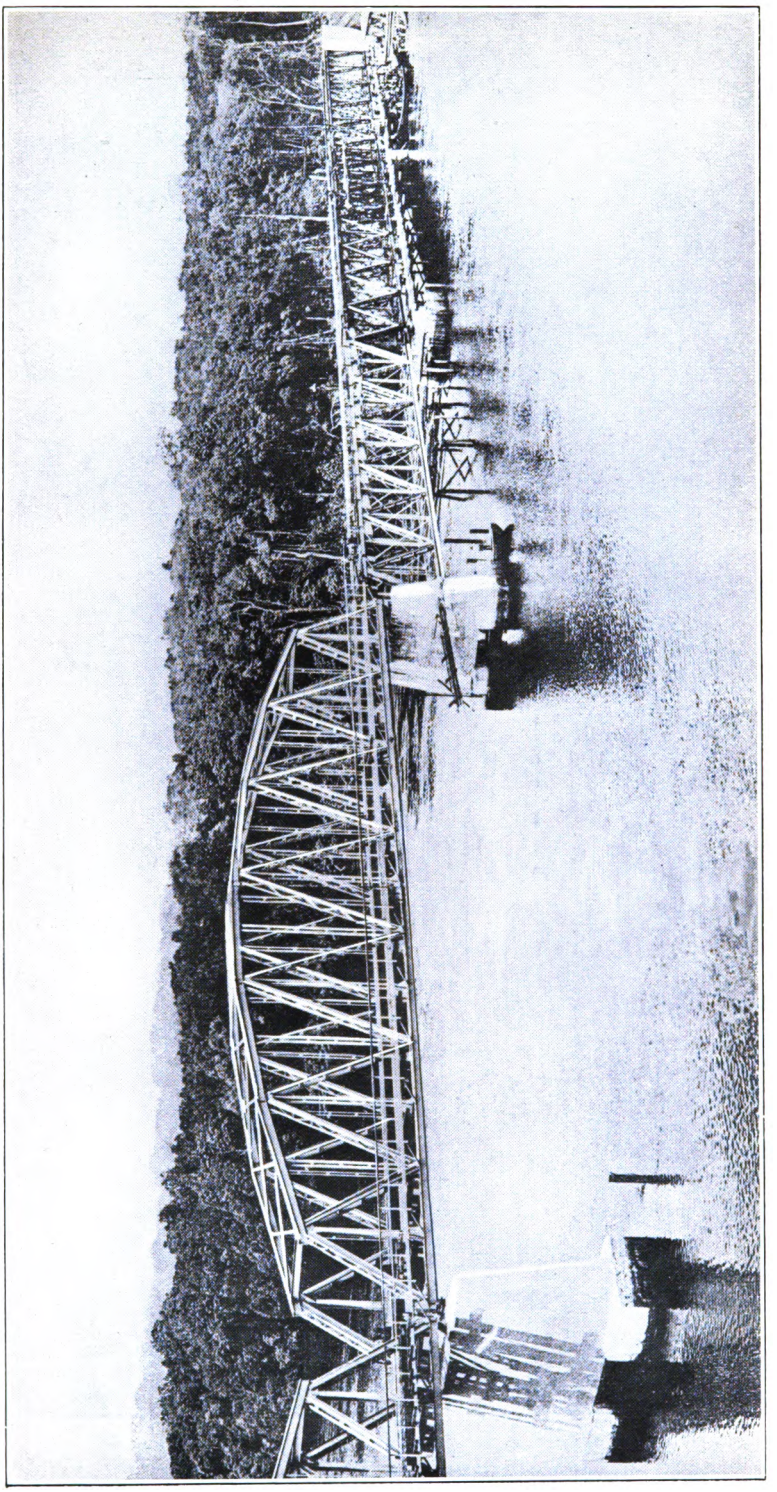
BRIDGE REPAIRS BY KAMERUN EXPEDITIONARY FORCE.



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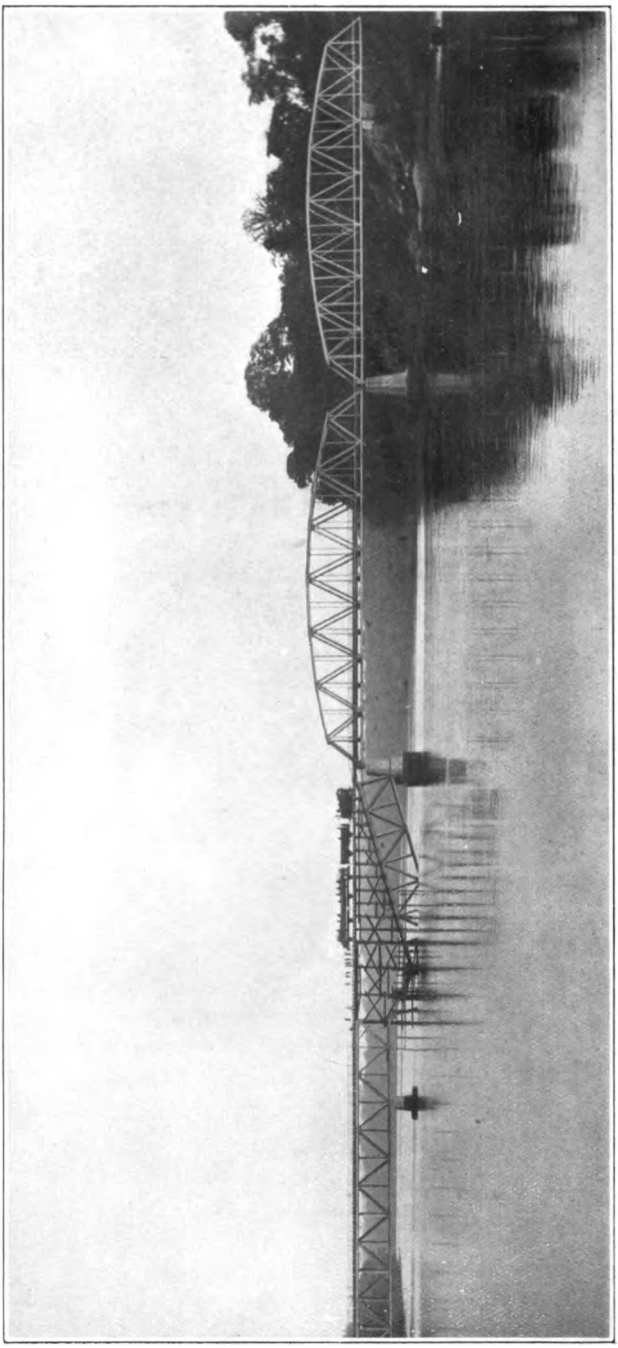
BRIDGE REPAIRS BY KAMERUN EXPEDITIONARY FORCE.



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BRIDGE REPAIRS BY KAMERUN EXPEDITIONARY FORCE.

A ROYAL ENGINEER officer in the Kamerun writes as follows :—

The enclosed photos may be of interest for publication. On their retirement from Duala the Germans cut two spans of the 5-span girder bridge (total length, 1,000 ft.) at Japoma over the river Dibamba, about 11 miles east of Duala.

The centre span was the one presenting most difficulty as regards repair owing to the depth of water (20 ft.) and a 3-knot current.

The repair was carried out by a French Railway Section which joined the Expedition from French Guinea and was placed under the orders of the Chief Engineer.

Piles were driven to support the existing girders in the positions in which they had fallen. Timber trestles were then erected on the upper flange of the dropped portion of the girder, and traffic has been running regularly since the repairs were effected.

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RUNNING COSTS OF MOTOR VEHICLES.

LIEUT. ROBERT W. A. BREWER, A.M.INST.C.E., M.I.MECH.E., F.S.E., in the course of a paper on "Running Costs of Motor Vehicles," read before the Society of Engineers recently, stated that the problem before the automobile engineer was to transport persons and goods in a minimum of time and at a minimum cost. The second consideration was, perhaps, the more important, and could be profitably discussed from an engineering standpoint. The main heads under which expenses might be classified were :—

(i.). Fuel cost and consumption.
(ii.). Lubrication systems and consumption of fuel.
(iii.). Wear and maintenance.
(iv.). Tyres.

As regarded fuel cost, it could not be said that a powerful engine was proportionately a greater fuel consumer than a similar one of less power, and the author discussed the factors producing economy in the use of fuel. The question of efficient lubrication was of the highest importance, but little progress had yet been made and further experiments were necessary. Piston friction also required more investigation, the most suitable form and material and the appropriate number of rings for a given type of car being yet undecided; attention was also directed to the problem of piston clearance. In valve mechanism there was little room for improvement, but the transmission losses had not yet been reduced to a minimum.

Gas friction caused loss due to the reduction of the volumetric efficiency of the engine, and efficient carburation played an important part in reducing loss from this cause, while changes of direction of flow should be made as easy as possible. At all diversions of the flow path a sufficiently high wall temperature must be provided to prevent precipitation. It was not so much the quantity of heat as its application at the correct points that was of the highest importance.

The author criticized the usual method of conducting fuel consumption tests, and indicated the importance of using an accelerometer when making such tests. The variation of the power required to drive a car was due largely to wind and rolling resistances. Total car resistance was also influenced by the balance of the wheels, engine parts, and propeller shafts.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF DELHI (*continued*).

The Major-General having communicated to the Chief Engineer his opinion that an assault *de vive force* was not expedient, attention was sedulously given to strengthening the position on the ridge, providing cover for the troops, clearing jungle and brushwood on the slopes, so as to diminish as much as possible the cover for the enemy, and finally to the security of the communications, by the demolition of all the bridges by which the enemy could cross the western Jumna Canal or Nujufghur Jheel Drainage Cut with his artillery.

On the 7th July a detachment of sappers and pioneers destroyed the Shalimar and Badlee Bridges, as well as a third bridge. These bridges had all superstructures of wood on masonry abutments and piers, and the demolitions were effected by the use of small charges sufficient to clear away the masonry retaining the girders, and by the subsequent removal of the latter and the roadway resting on them. The beams were required for use in the Engineer Park, and it was important to save them. On the 8th, the Busaye Bridge, the only remaining work of the kind on the drainage channel within moderate distance of the city, was also destroyed. On the 9th, the remaining bridges between the camp and Alipore were dismantled. On the same day, the Poolchuddun Aqueduct, of which the demolition had previously been only partial, was completely destroyed.

As part of a concerted scheme, apparently, a detachment of the enemy's cavalry charged into the camp on the 9th, and after causing considerable confusion and some loss was repulsed with heavy slaughter. A general attack was also made on the position under cover of a very hot fire from the place. A strong column under Brig.-General Chamberlain advanced through the suburbs, clearing them of the enemy, and driving him into the city. It suffered most severely however, the loss on this day being 228 in killed and wounded, considerably heavier than any other action in which the force had previously been engaged.

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The Engineer Brigade was, however, happily strengthened the same day by the arrival of 300 Punjab sappers armed, under the command of Lieut. Gulliver, and 600 pioneers unarmed, under Lieut. H. A. Brownlow. The latter had been formed by the Chief Engineer, on receiving orders to take command of the brigade, by volunteers taken from the workmen employed on the Ganges Canal at Roorkee. Strange to say, these men, who were at once transferred from the peaceful tasks of day labourers to the most dangerous duties of working parties in siege operations, never exhibited a symptom of fear, but worked under the hottest fire like veterans, and were invaluable. The casualties among them were inevitably very numerous, but no instance occurred of their having hesitated to obey any order, whatever its consequences might have been. Lieut. Brownlow brought with him under their escort a large supply of stores of various kinds for the Engineer Park, drawn from the workshops of the Canal Department.

Between the 10th and 14th July active work was carried on in strengthening the right flank of the position. Early in the siege, a lofty mound, evidently a disused brick kiln, had been taken possession of, its crest roughly formed into a battery for three heavy guns, and an approach of easy slope cut along its face. It was called "The General's Mound," from having been a favourite position of Sir Henry Barnard during the many fights of which he was an eye-witness. It was between this mound and a mass of ancient Mahomedan buildings abutting on the Nujufghur Jheel Channel that the enemy's cavalry broke through on the 9th, and it was necessary to make the ground impracticable for horsemen. Strong parapets, deep ditches, and thick abattis of trees and brushwood were carried over all the open spaces; provision was made for placing field guns in battery behind the bank on the right of the mound. The line to the drainage channel was thereby strengthened to be safe against attack.

Part of the ground in front of the Pagoda picquet being wholly unflanked and supplying cover frequently taken advantage of by the enemy, it was determined that a small battery for two field guns should be constructed on the right of Perkins's Mortar Battery, a position commanding the ground in question. There being reason to anticipate another general attack on the right of the position, the battery, for the sake of expedition, was built of sandbags, covered with a screen of gabions. The pioneers completed the work between 3 a.m. and 11 a.m. on the 15th, notwithstanding interruption from the enemy. This battery was called "Taylor's Battery," named after Capt. Taylor.

About sunrise the enemy attacked, as was expected, and the contest continued with variable vigour throughout the day. The position had been gradually so strengthened in all its parts that no

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impression could be made upon it. The troops remained quietly under cover of their parapets, and the artillery inflicted heavy loss on the enemy from all the batteries on the right. Scarcely any casualties had occurred until it was determined to move out and drive the enemy from the strong and rugged ground he usually held. This was done, of course, but with some loss, and in the impetuosity of pursuit the column followed the retreating enemy close up to the walls of the city. There they were received with a murderous grape-shot fire, and officers and men fell thick and fast. The commander of this column, Brigadier Chamberlain, was struck down by a dangerous wound, and before the troops could be extricated from their position, 13 officers and 209 men were placed *hors de combat*. The casualties in the Engineer Brigade included three officers, Lieut. J. T. Walker, Bombay Engineers, severely, and Lieuts. Geneste and Perkins slightly, wounded.

The total casualties in the two actions of the 10th and 15th having risen to nearly 500 men, it was necessary to abandon all idea of any active operations against the place from the latter date. Up to that date it had been the personal conviction of the Chief Engineer, duly submitted to the consideration of the Major-General commanding, that the possibilities of success by assault were such as would justify the attempt being made, should the political necessity for it be so great as to warrant very grave risks being accepted. It was no matter of regret to the Chief Engineer that his judgment on this point was never put to the test, it having been held that the risks were greater than the circumstances of the moment would warrant the General in meeting, but from this time his views were entirely in accordance with that conclusion, and thenceforward but one idea regulated the operations of the Engineer Brigade, to prepare, namely, by economy of men and material on the spot, and, by collection of the same from every available point for the breaching of the city walls, and the attack of the place by siege operations, followed by open assault.

On the 16th and 17th, the breastwork at the Pagoda picquet was strengthened, and a traverse constructed, batteries were repaired, and a magazine made for Taylor's Battery. Metcalfe's picquet was strengthened by a ditch in front of the cow-house. On the 18th a party of Major Coke's Corps raised and strengthened the breastwork between Johnson's Battery and the Crow's Nest. At Metcalfe's picquet, an officer and 40 men were employed during the night in endeavouring to ascertain the truth of the supposed existence of an enemy's mine under the stable. The noise of what seemed to be miners at work was distinctly heard, but ceased on our party commencing to drive a shaft in the stall of the stable where the noise was most distinctly heard. On the 19th another desultory attack was made on our right, which continued for some hours. Our men

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suffered but little loss while behind their trenches and breastworks; most of those hit being struck by shots from the Subzee-Mundee taking them in reverse. In the afternoon, a column under Brigadier Jones advanced and drove the enemy out of the Subzee-Mundee and Trevelyan Gunge. Lieut. Crozier, of the 75th Regiment, was killed on this occasion. On the 21st and 22nd the rear breastwork at the Metcalfe picquet was completed, very much improving the defences at that part, and placing them in a most satisfactory condition.

On the 25th—26th July, the lines of fire of the centre battery were altered and readjusted, so that one embrasure should bear on the Moree, a second on the Cashmere Bastion, and the third on Ludlow Castle. Lieut. Greathed, with 40 sappers, completed the demolition of the Rohtuk Road Bridge, leaving a gap exceeding 60 ft. in width.

Heavy rain fell on the 27th. The clearance round the Subzee-Mundee post was, however, continued, and the interior defences at the Pagoda picquet were strengthened and completed. On the left front the Flagstaff breastwork was improved. In addition to the above works, the preparation of gabions and fascines in the Engineer Park was continued daily without interruption.

By the 26th July no letters had been received for six weeks, all having been stopped or lost, and reinforcements were still expected. The enemy continued to make attacks on our position three or four times a week. Their average losses on each occasion amounted to some 300 or 400 men killed and wounded. Our position at this time was thoroughly entrenched on all sides, and perfectly secure from the enemy's attacks. About this time some attempts were made to destroy the bridge of boats across the Jumna River near the Selimgurh Fort, by floating down rafts, but without success. At this time we had been seven weeks in front of the city with a force of about 3,000 men, and had to repulse the enemy's sorties, which were sometimes made with a force of 10,000 or 12,000 men. One of the greatest discomforts at this period of the siege was the great plague of flies.

It was usual to watch the enemy's sorties from the batteries on the ridge. They sometimes occupied an hour in issuing from the city—cavalry, artillery, and infantry. The ground between the ridge and the city was very favourable for the enemy, being covered with rocks, trees, and bushes, from behind which they were able to pick off our men.

It may be remembered that the siege took place during the rainy season, so that the troops were continually drenched. The Engineer officers had to take parties of unarmed coolies out at dusk, and to work between the ridge and the city, their work usually consisting of felling trees and bushes, and clearing the ground in front of the

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picquets. Attacked by the enemy in the darkness and rain, it was really wonderful how patiently these poor coolies bore their sufferings, and their conduct was a matter of universal admiration. All the troops suffered alike. The officers received a daily tot or ration of rum like the men. Many now suffered from dysentery, and cholera had broken out. The commander of the Delhi Field Force, Sir Henry Barnard, as has been stated, was seized with cholera on the 5th July, and died in a few hours. Sales of effects of officers who had been killed, took place almost daily; a bottle of beer sold for 4 or 5 rupees, and a bottle of brandy for 20 rupees. Capt. A. Taylor was at this time second in command of the Engineers. He had a charmed life. It was his habit to go about alone, sometimes mounted, but more frequently on foot, between the ridge and the city, reconnoitring the enemy's position, and he seemed to have the faculty of dispensing with sleep. On several occasions he succeeded in penetrating, alone and in daylight, through the enemy's outposts, to study the ground on which our operations would have to be conducted.

Although during the sorties that were of almost daily occurrence the fighting generally ranged along the whole of the front of our position, the picquets stationed at the Subzee-Mundee may, perhaps, be awarded the palm for the deadly nature of the combats which they sustained, and for the severity of the fighting. Hand-to-hand combats were of frequent occurrence. On one occasion, during one of these fights, a rebel Sepoy thrust his head through an opening of the wall of the serai. A Goorkha Sepoy below the wall seized him by the hair and chopped off his head with one stroke of his kookree.

The route by which the troops marched from the camp to the ridge before arriving at the latter was much exposed to fire from the enemy's shot and shell throughout the siege. The shot fired from the city which missed the batteries on the ridge just cleared the top of the ridge and fell in the valley beyond. Dead camels, horses, and bullocks lay in every direction in this valley.

It now began to be understood in the camp that the mutineers had broken out into mutiny some days before the time decided upon by the confederation, at the head of whom was the Moolvie of Fyzabad. This is also the view taken by Colonel Malleson in his history of the Indian Mutiny, and he states that the date fixed upon was the 31st May. The punishment at Meerut of the 89 troopers of the 3rd Light Cavalry, who were sentenced by a court-martial to periods of imprisonment varying from six to ten years for refusing to take the greased cartridges, precipitated the Mutiny. It was commonly reported that out of 74 regiments of infantry in Bengal, only five remained staunch. News was received at this time that the Europeans at Agra had been compelled to retire

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into the fort, and also of the capitulation of Sir Hugh Wheler, at Cawnpore, and the subsequent massacre of all the Europeans at that station with the exception of Lieuts. Mowbray Thompson and Delafosse, and two privates, who escaped after undergoing wonderful adventures and sufferings. It was frequently believed, and stated both by officers and men at this period of the siege, that death would be preferable to falling into the hands of the rebels.

There were present at the siege two officers who subsequently rose to high rank, Lieut. Roberts (afterwards Commander-in-Chief in India, and Field Marshal Lord Roberts of Kandahar) and Capt. Donald Stewart (afterwards Commander-in-Chief in India, a baronet, and G.C.B.). Lord Roberts was D.-A. Quartermaster-General of Artillery during the siege, was wounded on the 14th July, and his horse was shot under him on the 14th September. Sir Donald Stewart commanded the volunteers serving in the Allygurh District in May and June, 1857, and all communications with the upper provinces having been cut off, he volunteered to carry dispatches from the Governor of the North-West Provinces to the officer commanding at Delhi. On arriving at the camp he was appointed D.-A. Adjutant-General of the Field Force, and served throughout the siege, and afterwards as Assistant Adjutant-General at the Siege and Capture of Lucknow, and in Rohilcund. Among other distinguished officers who were present at the siege were General Sir Henry Norman, G.C.B., Governor of Queensland, who was Adjutant-General after the death of Colonel Chester, killed at the Battle of Badle-ka-Serai, General Sir Charles Reid, G.C.B., who commanded all the advanced posts on the right of the Delhi Ridge, including Hindoo Rao's, the key of the position, during which 26 separate attacks were made, and also a column on the 17th June for the attack of Kissengunge, and the 4th column of assault on the 14th September, being severely wounded on that occasion, General Sir D. Probyn, K.C.B., V.C., who commanded the 2nd Punjab Cavalry, General Sir John Watson, V.C., and many others.

At dawn on the 12th August a column consisting of 350 1st Bengal Fusiliers, 100 2nd Bengal Fusiliers, 100 8th King's Regiment, 100 75th Regiment, 300 Coke's Rifles, 100 Sirmoor Battalion, 100 4th Sikhs, total 1,150 infantry, with cavalry and six guns in support, moved down to Ludlow Castle, to capture the two field guns which had been annoying us from the front of the stable of Metcalfe's house. The operation was successful, four light guns being seized on the road by Ludlow Castle, many of the gunners being bayoneted, and considerable loss inflicted on the enemy. Our loss was 19 killed and 90 wounded. Lieut. Sheriff, 2nd Fusiliers, was wounded mortally; Brigadier Showers and Major Coke, severely; Lieut. Owen, 1st Fusiliers, and the orderly officer to Brigadier Showers, lightly.

On the night of the 19th August, reports having been received

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that Lieut. Hodson—who had gone in the direction of Rohtuk, to watch a body of mutineers, supposed to have moved in that direction—was in difficulties, a force consisting of about 1,000 infantry, 200 Mooltanee Horse, some Guide Cavalry, and six guns under Major Tombs, the whole under Brig.-General Nicholson, marched at 11 p.m. to relieve him. The rain fell in torrents, and the column returned, having found the road impracticable beyond Alipoor. On the 22nd the enemy brought out three light guns, and about midday made a feeble attack on the centre battery, occupying the gardens below it, and firing up into the embrasures, but they retired again in the afternoon. On the 24th, Capt. Taylor, with Lieuts. Medley, Home and Thomason, made a reconnaissance of the ground from the Pagoda picquet to Marshall's house. The enemy's skirmishers fired heavily at the party, and one Goorkha was mortally wounded.

On the 25th August, Brig.-General Nicholson, with a force consisting of about 2,200 men of all ranks, and 12 guns, started at 4 a.m. to meet a body of the enemy, which, it was understood, had left the city on the previous day for Nujufgurh, with a view of coming upon our rear. In the evening he came upon them posted in strength near the village of Nujufgurh, and drove them from it with small loss, taking 13 guns. Several men from Coke's Corps and the 61st were wounded in an attack on another village, in which the enemy had taken refuge, and which was walled and difficult of access. Here Lieut. Lumsden, Acting Commandant of the Corps, was, unfortunately, killed, and also Lieut. Gabbett, of the 61st, and Lieut. Elkington, of the same regiment. The rebels left all their camp equipment behind them.

On the afternoon of the 26th the rebels attacked our right, bringing out six guns. Apparently, they supposed that the main body of our troops had gone out with Nicholson's column. About 50 sowars rashly charged up to within 50 yards of Salkeld's Battery, where many paid the penalty of their rashness with their lives. Our casualties were 12 in this affair. General Nicholson's column returned at dusk.

On the 27th a battery for six light guns was marked out in the Pagoda left trench. The enemy fired a good deal at our working parties, but without doing any harm, and our batteries sustained their fire.

On the 1st September, a shell fired from the other side of the river bursting in the Metcalfe stable killed and wounded nine men, these being the first casualties that had occurred from this battery.

On the night of September 3rd—4th, Lieut. Tennant (afterwards Lieut.-General, C.I.E., F.R.S.) was sent down to construct a battery for two light guns on the right of the 6-gun battery, to fire across the front of the Sammy House. A road for light guns was

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made to the 6-gun battery. A magazine was commenced for the 6-gun battery, but little progress was made owing to the stony soil.

The siege guns arrived on the 5th September, the remainder of the 60th Rifles on the 6th, and the Jummoo Contingent, led by Richard Lawrence, on the 8th. All was now ready for the breaching of the city walls and the subsequent assault.

Assault of Delhi and Capture of the City.

Before describing the siege operations which commenced on the 7th September, it will be as well here to mention briefly the leading characteristics of the place, the description being taken from the Chief Engineer's Report.

The eastern face of the city rests on the Jumna, and during the season of the year when our operations were carried on the stream may be described as washing the base of the walls. All access to a besieger on the river front is therefore, impracticable. The defences here consist of an irregular wall, with occasional bastions and towers, and about one-half of the length of the river face is occupied by the King's Palace, and its outwork, the old Mogul Fort of Selimgurh.

The river may be described as the chord of a rough arc formed by the remaining defences of the place. These consist of a succession of bastioned fronts, the connecting curtains being very long, and the outworks limited to only a crown work at the Ajmeer Gate, and Martello Towers mounting a single gun at such points as require some additional flanking fire to that given by the bastions themselves.

The bastions were small, mounting generally three guns in each face, two in each flank, and one in embrasure at the salient. They were provided with masonry parapets about 12 ft. in thickness, and have a relief of about 16 ft. above the plane of site. The curtain consists of a simple masonry wall or rampart, 16 ft. in height, 11 ft. thick at top, and 14 or 15 ft. at bottom. This main wall carried a loophole for musketry 8 ft. in height and 3 ft. in thickness. The whole land front was covered by a berm varying from 16 to 30 ft. in width, and having a scarp wall 8 ft. high. Exterior to this is a dry ditch about 25 ft. in width and from 16 to 20 ft. in depth. The glacis was a very short one, extending only 50 or 60 yards from the counterscarp. The ground occupied by the besieging force presents some features deserving of notice as having exercised a most important influence on the plan and progress of the works of the attack. On the western side of Delhi there appear the last outlying spurs of the Aravelli Mountains, represented here by a low ridge, which disappears at its intersection with the Jumna about 2 miles above the place. The drainage from the eastern slope of the ridge finds its way to the river along the northern and north-western faces of the city, and has formed there a succession of parallel or connected ravines of considerable depth. By taking

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advantage of these hollow ways, admirable cover was constantly obtained by the troops, and the labour of the siege was materially reduced. The whole of the exterior of the place presents a mass of old buildings of all kinds, of thick brushwood, and occasional clumps of trees, giving great facilities for cover, which during the siege operations proved, on the whole, more favourable to us than to the enemy.

In anticipation of the siege, means had been taken to store the Engineer Park with all the materials and tools required during the operations. The arrival of the siege train having placed the artillery in an equally satisfactory condition, ground was broken as soon after its arrival as possible, being on the night of the 7th September, 1857.

The project of attack submitted by the Chief Engineer to the Major-General commanding, and honoured with his sanction, provided for a concentrated rapid and vigorous attack on the front of the place included between the Water or Moree and Cashmere Bastions, provision being made at the same time for silencing all important flanking fire, whether of artillery or musketry, that could be brought to bear on the lines of advance to be taken by the assaulting columns. Due care was also taken to protect the exposed right flank of the trenches from sorties. The left was secured by being rested on the river, and by the occupation of the Koodsea Bagh, a very strong post in front.

The best information procurable indicated that on the front of attack the fire of some 25 to 30 pieces would have to be subdued. To effect this, 54 siege guns were available.

Capt. Taylor, as has been before mentioned, succeeded on several occasions in penetrating alone through the enemy's outposts, for the purpose of studying the ground, and on the general information so obtained, and his own knowledge of the locality, Major Baird Smith prepared the project of the attack. On the evening of the 6th September the project was formally considered by General Wilson. General Nicholson volunteered to accompany Taylor to see the ground and the points selected for the batteries. It was now dark, and they did not know the strength or disposition of the rebels. They went to some of the places of most importance, and found them unoccupied. Nicholson was satisfied, and reported what he had seen to General Wilson, who then gave his sanction to the Chief Engineer's proposals.

The plan of attack consisted, in principle, in establishing on the front of the fortification selected an artillery fire so much more powerful than that of the enemy on the same front that the result must be to silence his guns and crush his works. The Chief Engineer had good information that on the front between the river and the Cashmere Bastion not more than 30 heavy guns could be brought to bear upon our approaches. So arrangements were made for

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placing 56 pieces of siege ordnance, of various calibres, against this front, and in about four days the whole opened with terrific effect. Two excellent breaches were made in the walls within 48 hours; the cover for the enemy's infantry was at the same time utterly swept away; an incessant storm of shot and shell poured into the place, and on the 14th September all was ready for the final assault, which was accordingly given with brilliant success.

On the 7th September General Wilson issued an address to the troops, complimenting them upon their past conduct, warning them that the hardest part of their task was now about to begin, but assuring them that if they maintained their discipline they could not fail to succeed, and bidding them spare women and children, but give no quarter to mutineers. About the same time the last reinforcements arrived from the Punjab.

The officers and men were regularly practiced in the loading and unloading of the siege materials on camels, and every vicissitude that would be likely to occur was duly provided for. It was necessary that the attack should be directed against the northern face, represented by the Moree, Cashmere, and Water Bastions, with the curtain wall between them. The evening of the 7th was fixed for the commencement of the tracing of the assailing batteries. Under the orders of Lieut. W. Greathed, No. 2 Battery was traced. This battery was situated in front of Ludlow Castle, 500 yards distant from the Cashmere Gate. It was designed with the object of silencing the fire from the Cashmere Bastion, to dismantle the parapets of the walls to the right and left which gave cover to the defenders, and to open a breach to the stormers. About 1,400 camels were employed to carry the fascines and other siege materials. The camels were quietly loaded, and the working parties marched off at dusk on the evening of the 7th.

For about a fortnight previous to the commencement of the siege batteries, large working parties were sent out to cut the trees and bushes near the sites proposed for the batteries. The men were at work from dusk to dawn, groping and stumbling about in the long, rank jungle, wet through with the rain and dew, and frequently attacked by the enemy.

On the 9th, 10th, 11th, and 12th, the batteries were completed. These were of great size, built up to the soles of the embrasures entirely of fascines. 1,500 camels were employed nightly in carrying down the fascines. The third battery was completed on the night of the 11th. This battery was traced by Capt. Medley on the evening of the 9th. With a boldness which was not rare, but the display of which in this instance testified to remarkable negligence on the part of the enemy, the engineers supported by volunteers traced this battery within 160 yards of the Water Bastion. Seeking for a fit site for the battery, Capt. Medley discovered a small ruined

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building, an out-office of the Custom House, totally unoccupied by the enemy. Capt. Medley took possession of the Custom House, and determined to trace the battery inside the small ruined building, the outer wall of which would conceal the work, and give cover to the workmen. This daring measure completely succeeded.

Everyone expected that the attention of the enemy would be attracted on the first night to the grunting and noise of the camels, but, strange to say, the animals were unusually quiet. Strange, also, though it may seem, the enemy fired very little on the batteries which were under construction, although a heavy fire was concentrated upon them after they were completed and had opened fire. Almost all the engineer officers present, and fit for duty, were on duty for three nights continuously at this period.

On the 12th the batteries opened fire, and the first salvo carried away a large portion of the wall of the Cashmere Bastion. No. 1 Battery consisted of five 18-pounders, one 8-in. howitzer, four 24-pounders. No. 2 Battery was placed in front of Ludlow Castle, and consisted of two 18-pounders, nine 24-pounders, and seven 8-in. howitzers. A battery of six 9-pounders and two 24-pounders, under Major Remington, had been placed below Hindoo Rao's house, so as to play on the Moree Bastion. No. 1 Battery, which was within 700 yards of the walls, was planted in advance of this. Four guns of this battery were directed against the Cashmere Bastion, and six against the Moree Bastion. The batteries in this position were under the command of Major Brind.

There was also a battery of 10 mortars under Major Tombs, and another battery at the Custom House under Major Scott. During the construction of the former battery, a rocket fired from the Moree Bastion ricochetted among the coolies employed in the battery, killing 13. Their comrades placed the bodies in a row, and went on with their work as before.

From the 9th to the 14th, the morning of the assault, the pounding went on day and night from about 50 guns and mortars. The Moree bastion was soon silenced, and the line of parapet which sheltered the sharpshooters was stripped. The Cashmere Bastion was silenced in 10 minutes after the Ludlow batteries opened upon it.

In a letter from the Chief Engineer to Major Brind, commanding the artillery, the former wrote :—" No. 1 Battery was unquestionably the key of the attack, on its success depended the opening of Delhi to our assaulting columns. The progress of the other batteries depended essentially on its efficiency, and but for your moral courage, clear perception, and unwavering resolution in arming and working it in spite of all obstacles, consequences would have followed causing the greatest embarrassment."

The fire from the left section of No. 1 Battery had been steadily directed against the Cashmere Bastion, when about noon on the 10th

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the half-battery caught fire from the constant discharge of the guns. The rebels at once directed on the burning battery every gun they could command, and it was only saved by the gallantry of Lieut. Lockhart, who was on duty at the battery with two companies of the 2nd Goorkhas. Calling for volunteers, this officer jumped on the parapet, followed by six or seven Goorkhas, and, taking the sandbags from the top, they smothered the fire with the sand. Two of the Goorkhas were shot dead, and Lockhart was shot through the jaw, but by great exertions the survivors succeeded in extinguishing the fire.

On the 11th, the mortar battery opened fire, and Scott's heavy battery was unmasked.

An hour before noon on the 12th, No. 3 Battery on the left was unmasked. It was situated in the Old Custom House, and was constructed to a great extent of sandbags. It was here that Major Fagan, of the Artillery, was killed on the afternoon of the 13th.

In the Water Bastion the fire from the heavy guns at the Custom House, at 160 yards, played with fearful effect; the guns were dismounted and smashed, and the breach opened; while under the play of Tombs's mortars the curtain was literally stripped. The losses of the British from the enfilading fire of the enemy were very heavy, but the assault was no longer to be delayed and on the night of the 13th the order was issued for it to take place at daybreak on the following morning.

The dangerous duty of examining the breaches was performed by three engineer officers, Lieuts. Medley,* Lang,† and Greathed.‡ Medley and Lang crept out and reached the edge of the ditch undiscovered, descended into it, and although they saw the enemy was on the alert they carefully examined the breach. A volley was fired at them, but they returned unhurt, and reported the breach practicable. A similar report was received of the breach in the Water Bastion.

There were to be four columns of attack, with a reserve; the first was to storm the breach in the Cashmere Bastion, the second that in the Water Bastion, the third to enter by the Cashmere Gate, when, blown in by the engineers, and the fourth on the extreme right to clear the Kissengunge Suburb, and then enter by the Lahore Gate, while the reserve was to follow in the wake of the first three columns, and throw in supports when necessary.

The columns consisted of:—

No. 1.—Under General Nicholson, 1,000 men; engineer officers, Lieuts. Medley, Lang and Bingham.

* Lieut.-General Medley entered the Service in 1847, and died in 1886.

† Colonel Lang, C.B., R.E., subsequently head of the Thomason Civil Engineering College, Roorkee.

‡ Major-General W. W. Greathed, C.B., died December, 1878.

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No. 2.—Under Brig.-General Jones, 61st Regiment, 800 men; engineer officers, Lieuts. Greathed, Hovenden, and Pemberton.

No. 3.—Under Colonel Campbell, 52nd Light Infantry, 1,000 men; engineer officers, Lieuts. Home, Salkeld, and Tandy.

No. 4.—Under Major Reid, Commanding Sirmoor Battalion, 780 men; engineer officers, Lieuts. Maunsell and Tennant.

Reserve.—Under Brig.-General Longfield, 1,200 men; engineer officers, Lieuts. Ward and Thackeray.

After being told off to the different columns, the officers joined the storming parties, and marched with the column to their respective posts. The guns from the batteries, which had kept up a heavy fire during the night, suddenly ceased, and for a few minutes there was a lull in the firing, and an unusual stillness seemed to prevail. This was suddenly broken by a loud explosion from the Cashmere Gate, and by a fierce battle of musketry from the different columns of assault.

It was just daylight when the third column halted at a turn in the road which concealed them from view of the walls, but close to the Cashmere Gate. Lieuts. Home and Salkeld, of the engineers, and Sergts. Carmichael, Burgess and Smith, and four sappers, with Havildar Madho and Bugler Hawthorn, H.M. 52nd Regt., advanced from the column up to the gate. It was an immensely heavy wooden gate, flanked on all sides by the walls. Home laid the powder bags at the foot of the gate. The party was instantly discovered, and a heavy fire opened upon them from all sides. Sergt. Carmichael took the fuze, and was on the point of firing it when he was shot dead by a Sepoy who placed his musket through a hole in the gate. Sergt. Burgess took the fuze from his hand, and was also shot dead, Lieut. Salkeld then took the fuze, and was shot through the arm, and fell into the ditch, breaking his leg by the fall. As he fell he threw up the fuze, which Sergt. Smith seized, and fired the charge, and jumped into the ditch. At the same time the bugler sounded the advance, and on rushed the column. The charge blew up the gate, and about 17 of the enemy who were close to it. The following native officers, N.C.O.'s, and sappers formed part of the explosion party:—Subahdar Tooloo, Havildar Tillok (wounded), Havildar Madho (wounded), Sepoy Rambeth (killed), Sepoy Jahub Singh. Our troops rushed in at the gate, up the bastion, and along the walls. At the same time the first and second columns attacked by the breaches, and the walls were cleared of the defenders. The Cashmere Gate presented a terrible sight; several Sepoys had been blown up by the explosion, and others bayoneted or shot by the assailants, were lying all about. The same scene of carnage and destruction was visible along the walls and bastions. No quarter was asked or given. Almost every gun was dismounted and smashed by the fire from our guns, large pieces

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of iron being in many cases knocked out of the guns. Dead Sepoys lay about in all imaginable positions. The troops took up positions in the College and Church, but the enemy fired constantly during the whole of the night of the 14th. Hundreds of wounded men were carried by in doolies; General Nicholson was shot near the Burn Bastion while endeavouring to rally the men. At dusk a battery was constructed near the College, and commenced shelling the town and palace. The battery was under the command of Capt. Hamilton (afterwards Lieut.-General Sir W. Hamilton), and a heavy fire was kept up on the city from this battery during the whole of the night of the 14th. The losses in the assault and taking of the city were 64 officers and 1,380 men killed and wounded.

Surgeon H. T. Reade (now Surgeon-General and C.B.) was one of the first in the breach, and succeeded in spiking a gun. Capt. R. H. Shebbeare, 60th N.I., was severely wounded while endeavouring to capture a loopholed serai. The name of Ensign Phillips, 11th Bengal N.I., was proverbial on the Delhi Field Force for the number of gallant acts performed during the siege. He was thrice wounded, and captured the Water Bastion on the 14th September with a small party of men. This gallant and promising young officer was killed during the street fighting on the 18th. These officers were awarded the V.C. for their conduct on the 14th.

Among the non-commissioned officers who greatly distinguished themselves on the day of the assault were Colour-Sergt. Waller, 60th Rifles, by charging and capturing a gun; Sergt. MacGunnis and Drummer Ryan, of the 75th Regiment, by throwing ammunition boxes into the water, thus saving many lives; Lance-Corpl. H. Smith, 52nd Regiment, by removing a wounded comrade under a heavy fire at the Chandnee Chowk; Sergt. J. Smith and Bugler Hawthorn, who were with Lieuts. Home and Salkeld at the Cashmere Gate. All these men obtained the V.C., and Sergt. J. Smith afterwards obtained a commission. Scott's Field Battery, which had entered the city by the Cashmere Gate, had during all this time rendered splendid service to the several columns, but at a large expenditure of life.

At the assault on the 14th, the storming party under Capt. Baynes, H.M. 8th Regiment, lost the greater part of their number. On the same day, from a detachment of 200 men of the 9th Lancers, the losses were 6 officers and 42 men. Of the 17 engineer officers engaged, Lieut. Tandy was killed, and Salkeld died from his wounds a few days afterwards. Lieuts. Greathed, Maunsell, Chesney,* Medley, Hovenden and Pemberton were wounded. The losses during the fighting on the 14th were 8 European officers and 162 rank and file killed, and 510 wounded. Of natives 103 were killed and 310 wounded.

* Afterwards General Sir George Chesney, K.C.B., C.S.I., C.I.E., R.E.

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On the 16th the magazine was stormed by H.M. 61st Regiment, Wilde's Punjabees, and the Beloochees, the whole under Colonel Deacon, of the 61st. The enemy was surprised, and offered very little resistance, but in the afternoon made an attack in great force on the magazine. A heavy fire was opened on the turrets, where men of the 61st were posted to keep down the enemy's fire. The rebels set fire to the roof of the magazine, the fire being extinguished with much difficulty, and Renny, of the Artillery, got upon the roof with some 10-in. shells, which were handed up to him, and which he dropped on the enemy's heads. He dropped five or six shells in this manner, and many of the enemy must have been killed, as they ceased their attack soon afterwards. Capt. Renny and Lieut. Thackeray were awarded the V.C. on this occasion.

On the 18th a reconnaissance was made by Major Taylor who penetrated as far as the Chandnee Chowk; he found the houses partly occupied by their usual inhabitants, and not by an armed enemy. On the 19th, with a small detachment, Taylor worked through the houses and captured the Burn Bastion. The enemy kept up a slack fire during the night and shortly afterwards the palace was captured, and the whole city was in our possession. The defeated rebels fled in every direction, and the British flag once more waved over the walls of the capital of Northern India.

A memorial monument commemorates the capture of Delhi. The besieging army subscribed one day's pay towards its erection but this sum, though amounting to nearly 20,000 rupees, falling short of the estimate, the building was taken in hand by the Government, and completed at a cost of 21,400 rupees. It is built on the ridge, on the site of the right battery and being 110 ft. high, is visible from every point. It bears on its faces the names of the officers and men of the several British regiments, and of the British officers of the native regiments, who fell during the siege.

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THE ABOR EXPEDITION SURVEY DETACHMENT, 1911–12, *AND OF THE ABOR EXPLORATION SURVEY DETACHMENT,* 1912–13.

(*Concluded*).

By CAPT. O. H. B. TRENCHARD, R.E.

Reproduced by the kind permission of COLONEL SIR S. G. BURRARD, K.C.S.I., F.R.S., R.E., *Surveyor-General of India, from the "Records of the Survey of India," Vol. IV.*, 1914.

Early in the autumn of 1912 the Government of India decided, with the sanction of the Secretary of State, to renew during the ensuing cold weather the exploration of the Dihāng River Basin in continuation of the work of the previous winter.

The programme laid down for the season was as follows :—

(1). *The Dihāng Party.*—To explore and fix the Doshung La, and discover as much as possible of the geography north of the main ranges of the Himālayas ; ascertain the point where the Tsan-po breaks through the main range ; fix this range west of the Dihāng in conjunction with the Siom-Sigong party ; fix the main range as far as possible east of the Dihāng ; discover whether the course of the Nagong * Chu is north or south of the main range and whether it flows into the Tsan-po, the Dihāng or the Dibāng.

(2). *The Siom-Sigong Party.*—To fix the main range of the Himālayas in conjunction with the Dihāng party ; fix the courses of the Siom and Sigong Rivers and explore the passes said to be at the heads of these valleys ; endeavour to discover the course of the Nia Chu, whether it becomes the Subansirī, the Siom, or the Sigong, whether it flows north of the main range into the Tsan-po, or whether it breaks through the main range.

Under the orders of the Surveyor-General preparations had been proceeding in Calcutta throughout September, 1912, to enable the Survey Detachment to mobilize quickly should the proposals of the Government of India be sanctioned by the Secretary of State.

* The head-waters of which were discovered in about longitude 97° 0′ E., latitude 29° 30′ N. by A.K. in 1882.

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Sanction was received early in October, 1912, and communicated by the Surveyor-General on the 7th October with orders to collect the *personnel* of the detachment, who had been warned previously, and to proceed to Assam as soon as possible.

After making all final preparations and despatching the instruments, equipment, tents, etc., of the detachment (Capt. O. H. B. Trenchard, R.E., in charge; Lieut. G. F. T. Oakes, R.E.; Lieut. P. G. Huddleston, R.E.; Surveyor Hamid Gul; Surveyor Bhamba Ram; Surveyor Anwar Ali; 38 khalasis) by river steamer to Gauhāti, Capt. Trenchard left Calcutta on the 16th October, 1912, for Shillong in order to recruit Gurkhali khalasis for the detachment and ascertain what arrangements had been made by the Assam Government for the forthcoming exploration.

As soon as orders from Government were received, the Chief Secretary to the Chief Commissioner of Assam held a conference on 22nd October of all officers connected with the frontier explorations who were then in Shillong.

Details affecting the composition of the Abor Exploration Party were discussed and a rough scheme of operations formulated for the approval of the Chief Commissioner.

All the proposals made by the conference were accepted next day by the Chief Commissioner who appointed Mr. W. C. M. Dundas, C.I.E., Political Officer in charge of the Central and Eastern Sections of the North-East Frontier at Sadiyā, as Political Officer in charge of the Abor Exploration Party. Escorts consisting of the whole Lakhimpur Battalion Military Police were detailed. Orders were given to recruit 1,800 transport coolies, and the Army Department was asked to supply a mule corps, half a company of Sappers & Miners, and a cadre of British officers and non-commissioned officers of the Supply and Transport Corps for supply services.

With the assistance of Lieut. M. A. C. Kennedy, D.S.O., Adjutant, 1/8th Gurkha Rifles, all the khalasis of the detachment were carefully selected and medically examined before the end of October. Lieut. Oakes, Lieut. Huddleston and the three surveyors also joined the detachment in Shillong before the end of the month.

Owing to the prevalence of cholera in Gauhāti and on the Shillong-Gauhāti Road arrangements were made to transport the entire *personnel* of the detachment to Gauhāti by motor-car service and to embark it on the river steamer immediately on arrival in Gauhāti.

The detachment left Shillong early on the 4th November, 1912, picked up the equipment, etc., on arrival at Gauhāti and loaded it on to the steamer which sailed the same evening for Dibrugarh, where it arrived on the 7th November, 1912.

It was unfortunately only too obvious that the start of the main operations up the Dihāng would be considerably delayed, as the first necessity was to render the mule road, constructed from Pasighat

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to the Yembung River during the Abor Expedition, fit for traffic. This proved an arduous and lengthy undertaking as large portions of the track had been obliterated during the preceding monsoon season. The half-company of Sappers supplied by the Army Department did not reach Kobo until the middle of December, 1912, and the whole road was not reopened for mule traffic up to the Yembung River until the end of February, 1913.

The supply cadre and the mule corps lent to the local administration by the Army Department reached Kobo about the beginning and middle of December, 1912, respectively. The transport coolies also began to arrive in Kobo about the middle of December, 1912, and were employed on the carriage of rations up the mule road as succeeding sections were opened out by the Sappers (as a preliminary measure) for coolie traffic. The section of road between Kobo and Pasighat had been rendered passable for cart traffic by the Public Works Department during the preceding summer.

The first phase of the operations in establishing an advanced base in the Dihāng Valley at the head of the reopened mule road on the Yembung River may therefore be held to have been completed about the end of February, 1913.

It had been clear from the very beginning that little new survey work could be done during this period, as there is only one line of advance into the Dihāng Basin and this had been completely surveyed the previous winter.

A considerable quantity of useful work was however accomplished, with the assistance of the Political Officer in charge, between the middle of November, 1912, and the middle of January, 1913, while the other units of the party were collecting at Kobo, though it had perforce to be confined to the area south of the outer range.

In November and December, 1912, Lieut. Huddleston and two surveyors were able to extend the survey of the southern slopes of the outer range on the right bank of the Dihāng as far west as the Simen River, besides contouring the whole area in this direction surveyed during the previous winter. This section of the detachment and its escort were provided with transport by the Political Officer from local Abor villages, as none of the regular transport coolies had reached Kobo by then. No attempt was made to survey the belt of low-lying and densely-forested country between the southern foothills of the outer range and the north bank of the Brahmaputra; partly owing to the difficulties of obtaining a sufficiency of local transport and partly owing to the probability of incapacitating the *personnel* of the section in this malarious tract before the start of the real operations in the Dihāng Valley.

In the meantime Lieut. Oakes was employed in carrying out theodolite observations to complete the triangulation of the previous season.

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Having collected some Abor coolies from the villages near Pasighat he was able to proceed to Bapu Hill (one of the stations which Lieut. Field incorporated in the new series of triangulation in the spring of 1912), completed his observations and returned to Pasighat on 11th December, 1912.

The first batch of regular transport coolies had reached this place a few days previously from Kobo, but could not be employed fully on regular daily convoy work as the road above Pasighat was not yet open for traffic.

The Political Officer in charge readily agreed therefore to spare some of these coolies from the main line of advance for a short period, so Lieut. Oakes was able to cross the river from Pasighat on 14th December, 1912, with the purpose of observing from a new station on the outer range on the east side of the Dihāng and also of completing the survey of the southern slopes of the outer range between the Dihāng and Sesseri Rivers up to a marginal line previously arranged with the Dibāng Survey Detachment.

Bhamba Ram, the third and hitherto unemployed surveyor of the detachment, accompanied Lieut. Oakes. A satisfactory connection was made with the work of Capt. Gunter's surveyor along the low divide between the Dihāng and Sesseri Rivers by the 22nd December, 1912. The party then crossed the outer range (by a very difficult track) into the Yamne Valley, Capt. Oakes reaching the summit of Kine Hill (10,010 ft.), practically the highest peak in this section of the outer range, on 27th December, 1912. The next three days were spent in carrying out theodolite observations; Capt. Oakes rejoined the party at Sibbuk Village, and the party then returned down the left banks of the Yamne and the Dihāng and recrossed to Pasighat on the 4th January, 1913.

The computations of these observations were worked out by Capts. Trenchard and Oakes in Rotung by the end of January, 1913; the co-ordinates and heights were thus obtained of 24 entirely new points and of 13 other points which had only been fixed provisionally by the triangulation carried out during the expedition. Most of these points were snow peaks situated on the main range, the general outline and direction of which began therefore to be more clearly defined.

The main outlines of the plan of operations for carrying out the survey programme had been settled by the Political Officer in charge before the close of December, 1912.

It was decided that the main advance up the Dihāng Valley from the head of the mule road at the Yembung River should be along the right bank, both to avoid the dangers of an inevitable Dihāng River crossing on the line of communications attendant on the alternative route along the left bank and also to simplify the maintenance of a detached party working in the Siom Valley.

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In order that the operations of this Siom party should not unduly delay the main advance up the Dihāng Valley, the Political Officer in charge decided to restrict the number of regular transport coolies employed by it to the minimum required for carriage of baggage and a small reserve of rations; thus making the party dependent on obtaining local Abor labour for the carriage of its surplus rations, to be sent out to it monthly from the main line of communications in the Dihāng Valley.

This bold policy proved on the whole eminently successful, thanks largely to the ability, tact and knowledge of the Abors and their language displayed in the conduct of the operations of this party by Capt. Hore, in political charge. Seeing that the Siom Valley had to all intents and purposes not been visited during the Abor Expedition and it became very clear as the advance of the Exploration Party progressed that the only section among the Abors really impressed by our military superiority, as a result of that expedition, was the actual Kebang Group, against which military operations had been directed, the success achieved by the Siom party may be considered remarkable.

Lieut. Huddleston and Surveyor Hamid Gul accompanied this party, which left Rotung on the 24th January, 1913, and started work in a hitherto unsurveyed area at Kombong Village in the south-eastern corner of the Siom Valley on 28th January, 1913.

By the middle of January, 1913, mule convoys were running daily up to Rotung. The final stage of this road to the Yembung River had still to be re-made and seven stages (about 100 miles) for coolie transport of the main line of communications beyond it had to be established before the surveyors could start work in the unsurveyed area of the Dihāng Valley north of latitude 28° 55′. The only immediate survey operation therefore for the remainder of the detachment was the extension of the series of triangulation up to the snow-covered (and treeless) spur which juts out west into the Dihāng Valley about latitude 28° 45′ from the Dihāng-Dibāng Watershed.

From stations on this spur theodolite observations would not only provide intersected points for the surveyors working in the untriangulated area of Pemakoi-chen but would also determine the general position and direction of the main range east of the big Namcha Barwa Peak in longitude 95°.

The easiest route to this spur lay up the Yamne Valley which rises in its southern slopes.

The Political Officer in charge agreed to the despatch of a party with this purpose and decided to accompany it himself, both to make the political acquaintance of the Padam Abors and to supervise the recruitment of the local Abor coolies required for the transport of the party.

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Capts. Trenchard and Oakes accompanied the party to carry out the triangulation and Surveyors Bhamba Ram and Anwar Ali to contour the Yamne Valley.

The party crossed from Rotung to the left bank of the Dihāng and reached Porging Village near the mouth of the Yamne on the 3rd February, 1913. It marched up the right bank of the Yamne to Sibbum Village, then crossed the river and proceeded through Sibbuk Village to Damro which was reached on the 11th February, 1913.

On this date the weather, which had been extraordinarily good ever since the detachment reached Dibrugarh early in November, 1912, broke up and a period of constant rain and mist set in for the next three months.

It was realized that the somewhat hazardous mountaineering feat of reaching the top of the peaks of this spur in bad weather and the waiting thereon for a fine interval would consume too much time and entail the withdrawal of numbers of coolies from the main line of advance up the Dihāng Valley. It was therefore decided to abandon the attempt and to make other arrangements for extending the series in the main valley itself, and in the vicinity of the line of communications.

After completing the re-survey and contouring of the Yamne Valley the party crossed the divide into the Dihāng Valley on 25th February, 1913, and reached Geku Village next day. From here Capt. Oakes and Surveyor Bhamba Ram crossed to the right bank of the Dihāng and marched to Dosing Village, near the confluence of the Shimang River, with a view to proceeding up that valley and working beyond it in the Sike Valley to assist the Siom party.

Capt. Trenchard and Surveyor Anwar Ali accompanied the remainder of the party on the return journey down the left bank of the Dihāng River to the ferry below Rotung, which was reached on the 9th March, 1913, and then proceeded up the right bank of the Dihāng with the Political Officer in charge to Dosing.

On reaching that place on 14th March it was found that the arrangements for extending the main line of communications up the valley had been disorganized somewhat by rumours of coming warfare with the Abors further north.

It was therefore found necessary to curtail the scope of Capt. Oakes' work beyond the limits of the Shimang Valley. He returned to Dosing with Surveyor Bhamba Ram on the 26th March, 1913, after meeting the Siom party at Bogu Village in the Siom Valley, and having completed the re-survey and the contouring of the Shimang Valley.

Final arrangements to ensure a methodical advance up the Dihāng Valley were then made; the Assam Government having agreed to supply a reinforcement of 1,200 transport coolies for which the

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Political Officer in charge had asked early in March. These extra coolies reached Kobo in April and were at once sent up to the head of the line.

By the 24th April, 1913, the line of communications had been extended to the Angong River Confluence where the main party was rejoined by the Siom party, on completion of its work in the Siom Valley. Henceforth it ceased to exist as a separate party, exactly three months after it was constituted as such in Rotung.

As mentioned above the Siom party reached Kombong on the 24th January, 1913. Surveyor Hamid Gul first accompanied Capt. Hore into the south-west corner of the Siom Valley and completed the survey of that portion of the lower Siom Valley up to the Subansirī Watershed before he rejoined the rest of the party at Along Village on the Siom River on the 11th February, 1913.

In the meantime Lieut. Huddleston crossed to the left bank of the Siom River from Along and completed the survey of the valley of the Sirit, a small tributary of the Siom, before rejoining the party at Along.

The small area between the Sirit Confluence and the mouth of the Siom was surveyed towards the latter part of April, 1913, by Surveyor Anwar Ali.

The whole party proceeded up the right bank of the Siom River from Along and reached the confluence of the Sike River, the big northern tributary of the Siom, on the 14th March, 1913.

Despite the almost continuous rain experienced during this period the valley was surveyed right up to the Subansirī Watershed, and Surveyor Hamid Gul also managed to sketch in the head-waters of the Siu River, a big tributary of the Subansirī not completely surveyed by the Mīri Mission during the previous season.

On the 17th March, 1913, the whole party crossed the Siom River to Bogu Village on the left bank, and picked up its third and last month's supply of rations which had been sent out by convoy up the Shimang Valley from Dosing, on the main line of communications in the Dihāng Valley. It then crossed the Sike and reached Yiyu Village on the left bank of the Siom on the 25th March, 1913. A depôt of rations to feed the party on its return journey (by way of the Sike Valley) to the main line of communications in the Dihāng Valley was formed at Yiyu, and the rest of the party continued along the left bank of the Siom to complete the survey of the top portion of that valley. Ro Village was reached on the 27th March, 1913. Between Ro and the next village Pa-um the Siom breaks through a snowy range of mountains in a very narrow gorge. This range, known north of the Siom as the Pari and south of it as the Yorjing Mountains, is a very large spur of the main Himālayan Range and approximately follows the 94° 30′ meridian from north to south.

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The Pari Mountains form the watershed between the Sike Valley and the top portion of the Siom Valley, while the Yorjing Mountains divide the valleys of the Siom and the Subansirī.

The trade path to the upper portion of the Siom Valley is very difficult throughout the whole length of the gorge, crossing several sheer rock faces (on which the path degenerates into a series of precarious footholes) at an altitude of about 3,000 ft. above the river bed.

The first of these cliffs, Pu-U, was encountered between Ro and Pa-um Villages. It proved so serious an obstacle that it was impossible to get any of the loads or most of the coolies across it, and the party possessed no means of improving the track by the only possible method of blasting it out of the rock face.

Moreover the attitude of the Boris, which had been distinctly unfriendly since the party entered their territory a short distance below the Sike Confluence, became openly hostile at this juncture and Ro Village had to be punished on the 29th March, 1913. Capt. Hore then decided in consultation with Lieut. Huddleston that, in view of the necessity of getting the whole party back to the main line of communications in the Dihāng Valley before its rations were exhausted, no further attempt should be made to proceed further up the Siom Valley but that the party should spend the remaining time at its disposal before returning to the Dihāng Valley in completing the survey of the Sike Valley and any other northern tributaries of the Siom.

In pursuance of this decision—the only possible one under all the circumstances with regard to the main objective of the Exploration Party in the Dihāng Valley, even though it entailed the non-fulfilment of one of the items of the survey programme laid down by the Government of India—the party returned to Yiyu, picked up the depôt there and marched up the right bank of the Sike River to Gasheng Village which was reached on the 11th April, 1913. From here Lieut. Huddleston and Surveyor Hamid Gul managed to reach the top of a peak on the watershed between the Sike and Sirapateng (Sigong) Valleys from which the survey of the head-waters of the former valley was completed and a useful start in the survey of the latter valley was made.

They rejoined the rest of the party, which had meanwhile been progressing slowly up the Sike Valley from Gasheng Village, on the 17th April and then crossed that river into the valley of the Sirang, a small tributary stream, up which the party proceeded to a pass over the top of Luyor Hill—a peculiarity common to many Abor paths—situated at the head of the Sirang and on the watershed between the Sike and Dihāng Rivers.

After halting on this hilltop for four days, the fourth day fortunately being fine and clear, the party marched down the Nidgong

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River, a Dihāng tributary which like the adjoining and parallel stream the Angong flows from south to north, to Mosing Village which is built on top of a commanding bluff between the two tributaries and immediately above a deep and narrow gorge through which the Dihāng flows below this village.

From Mosing the party marched down to the Angong River Confluence on the 24th April, and rejoined the main party.

With the exception of Surveyor Anwar Ali, whom it was found impossible to employ after the end of April, 1913, owing to lack of transport and who therefore remained in reserve at the advanced base on the Yembung River for the remainder of the season, the whole detachment were collected at or near the head of the line of communications at the Angong River Confluence by the beginning of May, 1913. Capt. Oakes, who had been incapacitated for the whole of April by an attack of mumps, reached the Angong River from Dosing on the 3rd May ; and Surveyor Bhamba Ram completed the contouring of the whole area in the Dihāng Valley surveyed during the previous season up to latitude 28° 55′ by the 9th May, 1913.

Owing to the failure experienced in February, 1913, to extend the series of triangulation to the range at the top of the Yamne Valley, the northern portion of the Dihāng Valley, known as Pemakoi-chen, which the Exploration Party was now about to enter, had to remain untriangulated up to this.

Lieut. Huddleston had, however, fortunately discovered on crossing the watershed between the Sike and the Dihāng that Luyor Hill on that divide would make a suitable station and that another high hill (Dino) in the vicinity of Pango Village on the line of advance could probably be utilized as a second station from which the necessary points in Pemakoi-chen might be fixed.

A third hill (Loyung) in the vicinity of Bomo Village further down the Dihāng Valley and, like the other two, close to the line of communications, was selected as an intermediate station to connect the two forward stations with the series.

The Political Officer in charge having made all arrangements for escorts, supplies and transport immediately the suggestions for this triangulation had been put before him, the three survey officers were able to leave the Angong River to execute it before the middle of May, 1913.

Capt. Oakes reached the top of Luyor Hill on the 9th May, 1913, but owing to bad weather was not able to complete his observations until the 20th May, 1913.

Lieut. Huddleston reached the top of Loyung Hill on the 10th May, 1913, and had a very heavy job cutting down the trees on it. He managed however to complete all his observations by the 20th May, 1913.

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Capt. Trenchard accompanied by Surveyor Hamid Gul left the Angong River on 10th May, 1913, to clear the top of Dino Hill and erect a signal for the other two triangulators to observe to. This was completed on the 15th May, 1913.

Capt. Oakes after completing his observations from Luyor Hill proceeded at once to Dino Hill which he reached on the 22nd May, 1913. Another spell of bad weather delayed the completion of his observations there until the 3rd June, 1913.

By this time the head of the line of communications had been advanced across the Sirapateng River and had reached Tuting, the most northerly Abor Village on the right bank of the Dihāng. Computations of all the recent triangulation were completed by the 13th June, 1913, as a result of which 40 new points were provided for the plane-tablers. Although Capt. Oakes was able to observe from one more hill (Nishing) north of Tuting Village before the end of June and obtain six more new points it was not found possible to extend the series north of latitude 29° 0′ before the close of the season.

Compared with the lower portion of the Dihāng Basin Pemakoichen proved an easy country to survey. It is not only more populous and therefore less densely forested than the Abor country; the bold lofty spurs which run down from the main range to the river enable the plane-tabler to climb above the tree level and therefore to work far more rapidly than he can in the Abor Hills of lesser altitude.

During the first week of June, 1913, Surveyor Hamid Gul spent some days in bivouac at altitudes between 11,000 and 14,000 ft. on the Dipung Ridge, which divides the two right bank tributaries Ringang and Nugong; from which he was able to complete the survey of the Yang Sang Chu Valley on the opposite side of the Dihāng.

Working at the same altitudes Surveyor Bhamba Ram practically completed the survey of Ringang Valley between the 3rd and 13th June, 1913. He was not able to reach the pass (Lushe La) at the head of this valley by which the Abors state a track crosses the main range into the Tsan-po Valley, as this path ceased to be practicable for loaded coolies half-way up the Ringang Valley.

The head of the line of communications was established at Kopu, the most southerly Pemakoiba village on the right bank of the Dihāng, on the 14th June, 1913. The hot weather had set in by this time, the original transport coolies had been working continuously for six months, and it was obvious that operations in the Dihāng Basin could not be continued for much longer.

The Political Officer in charge decided therefore not to extend the line of communications beyond Kopu, but to continue the advance up the Dihāng with a small self-contained party (carrying rations for 20 days) before returning to Kopu. It was also arranged that

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another small party should make a similar journey up the Sirapateng (Sigong) Valley to complete the unsurveyed portion at its head and reconnoitre the pass over the main range by which a track was said to lead into the Tsan-po Valley.

The Dihāng party left Kopu on the 23rd June, Capt. Trenchard accompanying it, and picked up Capt. Oakes and Surveyor Hamid Gul, who had spent the previous week observing from the Nishing ridge and completing the survey of the Nugong Valley, on the evening of the same day.

The party reached Janyor Village on 26th June, where Surveyor Hamid Gul was detached to ascend the Jijung Ridge between the Nugong and Pemasiri Valleys. The remainder of the party reached the Pemasiri River (near Yortang Village) on the following day.

On the 28th June, 1913, Capt. Trenchard left the main party and with a small escort commanded by Capt. Pemberton, R.E., marched up the left bank of the Pemasiri River, reaching Ani Basam, one of the halting places on this important trade route just beyond the junction of the Pemasiri and the Doshung Chu that evening. On the following day he crossed the divide into the Doshung Valley and marched up the left bank of that river to the pass (the Doshung La, about 13,500 ft.) over the main range at the head of the valley. The pass, an easy one, was crossed on the 2nd July, 1913. Next day the party reached Phea Doshung, a small village on the right bank of the Tsan-po about half-way between the villages of Chilagong and Gyala, and was received in a friendly and hospitable manner by the villagers. Chilagong is an important, if not the principal, village of the Kongbu District of Tibet and is three days' ride west of Phea Doshung. Gyala is two days' ride north-east of Phea Doshung.

The 4th July was spent on a neighbouring hill, but unfortunately bad weather prevented any trigonometrical observations being carried out. A plane-table sketch however was made of the portion of the Tsan-po Valley visible from this hill and of the neighbouring areas compiled on the spot from the topographical information freely given by the local inhabitants. Lack of time and rations and the necessity of rejoining the main party in the Dihāng Valley on the arranged date rendered it impossible to continue the march from Phea Doshung to Gyala.

The headman of Gyala reached Phea Doshung however on the evening of the 4th July to visit the party and absolutely confirmed Kinthup's account of the Tsan-po breaking through the Himālayas just below his village and flowing into Pemakoi-chen on the other side of the mountains in a very deep and impassable gorge. About the falls this headman was reticent and contradictory; the general impression he gave both officers of the party was that falls undoubtedly do exist even if they are not as big as described by Kinthup.

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With the knowledge that Capts. Bailey and Morshead were on their way to settle this question definitely as a partial consolation for the disappointment of not being able to forestall them, the party left Phea Doshung on the 5th July, 1913, recrossed the Doshung La the following day, and rejoined the main party on the Pemasiri River on the 9th July, 1913.

Owing to continuous bad weather both on the outward and return journey it was not found possible to survey the Doshung Valley in detail nor even to make any astronomical observations. A prismatic compass traverse of the whole route was executed, which will be adjusted eventually with Capt. Morshead's survey in the Tsan-po Valley.

The reconnaissance survey, based on this traverse, of the whole area covered during this exploration is however fairly complete.

On the 29th June, 1913, the Political Officer in charge, Capt. Oakes and the main party continued the advance from the Pemasiri River up the right bank of the Dihāng River. On the 4th July they reached the Chhanjuk La, a pass of low elevation on the south-eastern extremity of the watershed between the valleys of the Pemasiri and the Nyalam Chu.

Capt. Oakes completed the survey of the Dihāng Valley in detail up to this watershed on the right bank; on the left bank he completed the survey up to the confluence, near Khapu Village in about latitude 29° 30′, of the big left bank tributary, the Chimdru Chu, thus effecting a very satisfactory connection with the survey Capt. Morshead will have made in that valley and also in the Dihāng Valley north of latitude 29° 30′.

The party found on reaching the vicinity of Khapu that Capt. Morshead had left that village a short time previously and was proceeding up the left bank of the Dihāng towards Pomed. He had been informed previously of the extreme northern limits to which the surveys of the Abor Exploration party could be carried.

Owing to the time limit imposed by the arrangements for the retirement of the whole exploration party made before the Dihāng party left Kopu, the Political Officer in charge and Capt. Oakes were unable to continue their journey across the valley of the Nyalam Chu, the last of the big mountain torrents on the right bank of the Dihāng, and reach the eastern end of the big gorge through the Himālayas.

The return journey down the Dihāng Valley was started on the 5th July, 1913, the Pemasiri River being reached on the 9th July, 1913.

Surveyor Hamid Gul, having reached the top of the Jijung Ridge from Janyor Village on the 28th June, 1913, spent a week in completing the survey of the southern and western portions of the Doshung Valley up to the crest of the main range. Continuous bad

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weather prevented him from completing the detailed survey of the whole of the Doshung and Pemasiri Valleys; he was however able to do a certain amount of reconnaissance work which, combined with that of Capts. Trenchard and Oakes in this area, provides a complete and fairly accurate survey of the main range at the head of the Doshung and Pemasiri Valleys up to the big Namcha Barwa Peak, and also of the two valleys up to the Pemasiri-Nyalam Chu Watershed which takes off from the main range in the vicinity of that peak. Surveyor Hamid Gul rejoined the main party at the Pemasiri River on the 9th July, 1913.

Next day the reunited party started its long march down the Dihāng Valley, acting as the rear guard of the whole exploration party during the retirement to Kobo, which was reached on the 9th August, 1913.

While the main Dihāng party was making its final advance up that valley Lieut. Huddleston and Surveyor Bhamba Ram accompanied a small party under the command of Capt. Hore up the Sirapateng Valley. Leaving Miging Village on the main line of communications in the Dihāng Valley on the 19th June, 1913, the party crossed to the left bank of the Sirapateng (Sigong) River at Kerak on the 21st June and continued its advance up the valley. The junction of the Simu with the Sirapateng River was reached on the 27th June and from here the party proceeded up the left bank of the Simu River to the top of the valley, reaching the Lungma (Lulung) La, the 13,500 pass on the main range by which the track crosses into the Tsan-po Valley, on the 30th June.

Orang Gacha, a village on the right bank of the Tsan-po, is said to be only two days' march by a good *Yak* road from the Lungma La. The party had been delayed considerably in its advance up the Sirapateng Valley by the extremely bad condition of the alleged trade route. Much time was spent in repairing and rebuilding the cane bridges over the numerous side streams, all of which were in flood from the continuous rain experienced throughout the whole journey.

The party was unable therefore to continue its advance over the Lungma La into the Tsan-po Valley in the time allotted for this exploration, nor could Lieut. Huddleston carry out any survey of the western slopes of the main range from the pass. The continuous bad weather made it impossible even to survey the Sirapateng Valley in detail; a prismatic compass traverse of the route was made and the reconnaissance survey of the whole valley based on this traverse is complete and very fairly accurate.

The party returned to Miging Village on the 7th July, 1913, where Lieut. Huddleston was employed for the next week in determining an accurate height by theodolite observations for the Sirapateng Confluence. Thence he and Surveyor Bhamba Ram marched down

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the Dihāng Valley, reaching Pasighat on the 26th July and Kobo on the 9th August, 1913.

The whole detachment embarked on a river steamer at Kobo on the 14th August and reached Gauhāti on the 17th August, where the khalasis were paid off and discharged.

The officers and surveyors of the detachment, who had been transferred to the headquarters of the Eastern Circle on demobilization of the Abor Exploration party, reached Shillong on the 18th August, 1913.

Despite the length of the season, which lasted from the 7th November, 1912, until the 14th August, 1913, the detachment did not experience much sickness. One officer had an attack of mumps in April, 1913, and the other two officers suffered from malaria during the return journey to Kobo in July and August, 1913. The surveyors and khalasis escaped serious sickness in a remarkable manner; only one khalasi had a mild attack of pneumonia during March, 1913.

A short recapitulation of the Survey work accomplished in the basin of the Dihāng River partly during 1911–12 but mostly in the season 1912–13 will show to what extent the requirements of the Government of India have been fulfilled.

With exception of the head-waters of the Siom River the whole area of the Dihāng River Basin, from the Brahmaputra River in the south to the confines of Tibet and Pomed in the north, has been surveyed in detail—for the most part rigorously—on the scale of 4 miles to 1 inch, the hill features being delineated by approximate contours at 250-ft. vertical interval.

Satisfactory connections along the entire lengths of the common margins have been made with the surveys of the Dibāng Exploration party to the east along the Dihāng-Dibāng Watershed, and with the surveys of the Mīri Mission of 1911–12 to the west along the Dihāng-Subansirī Watershed.

The southern slopes of the outer range of the north bank of the Brahmaputra River from the Simen River in the west to the Sesseri River in the east, an area which, strictly speaking, is not contained in the actual basin of the Dihāng River, have also been surveyed in detail.

The detail surveys are based on a good minor series of triangulation which emanating from the Assam Valley (G.T.) series in the Brahmaputra Valley, has been carried over the outer range and extended into the Dihāng Valley up to latitude 28° 55′. From this series of triangulation 30 peaks have been intersected on the main range of the Assam Himālayas bounding the basin to the north and north-west which determine the position and direction of the range from longitude 94° in the south-west to longitude 95° in the north-east.

The greater portion of the entire length of this section of the main range has also been surveyed in detail (on the Dihāng side)

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up to the crest of the range; only the small portion at the head of the Siom Valley between longitude 94° and 94° 15′ has not been surveyed in addition to being fixed by triangulation.

Two passes on the main range by which the two main trade routes from the Dihāng Valley cross into the Tsan-po Valley—the Doshung La at the head of the river of that name, and the Lungma (Lulung) La at the head of the Simu branch of the Sirapateng (Sigong) River—have been accurately fixed and the routes leading to them surveyed. In addition four passes of minor importance, the Deyan La and Demya La at the top of the Nugong Valley, the Lushe La at the top of the Ringang Valley, and an unnamed pass at the head of the Sirapateng River, have been fixed approximately; the paths leading to them were not completely surveyed only because they were found impossible for loaded coolies.

Finally the approximate positions of the Nam La, by which the route from the northern part of Pemakoi-chen up the Nyalam Chu crosses the main range to Gyala, and that of the Tunga La at the head of the Siom Valley have been obtained from local information.

The course of the Dihāng River itself and those of all its tributaries south of latitude 29° 30′ (except the head-waters of the Siom) have been accurately surveyed up to that parallel.

The correct position of the Tsan-po River in the neighbourhood of Gyala has also been determined, which enables us to correct the course of that river as shown on existing maps from Chetang to Gyala; and a certain amount of new geographical knowledge about the country to the north of the main range has been obtained.

The identity of the Tsan-po and the Dihāng as one and the same river has been established to all intents and purposes. Kinthup's statement that the Tsan-po broke through the Himālayas from Tibet to Pemakoi-chen in a deep gorge has been confirmed, the position of this gorge has been fixed with a fair degree of exactitude, and only a short length of the Dihāng River (probably not more than 30 miles measured along the bends of the river) between latitude 29° 30′ and the eastern end of the gorge in about latitude 29° 45′ has not been surveyed, though actually we are able to show this small portion on the map with tolerable certitude from local information pending the final confirmation of Capt. Morshead's surveys.

These will also confirm and of course correct the sketch map, which has been compiled from local information, of the areas known as Potodh, Pomed and Poyul which lie to the north of Pemakoi-chen and which are drained by the big river Po Tsang Chu and its tributaries.

The head-waters of this river (known as Nagong Chu) were discovered by Surveyor A.K. in the autumn of 1882 flowing west after rising in the mountains in which Shuiden Gom-pa is situated in about latitude 29° 30′, longitude 97° 0′.

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It is now clearly established (though actual surveys in confirmation are still wanting) that this Nagong Chu or Po Tsang Chu does not flow into the Dibāng River or into the Rong Thod Chu, but that it joins the Dihāng River in the vicinity of Gompone Monastery at or near the eastern end of the big gorge through the Himālayas. Whether this river pierces the main range at any point higher up in its course must remain a moot point until the question is settled on Capt. Morshead's return to India; all the evidence we have obtained up to the present points to the fact that the big range of mountains discovered by A.K. in 1882 on his return journey to Lhāsa from Shuiden Gom-pa, which bounds Potodh, Pomed, and Poyul on the north, and divides that country from the valley of the Giama-Nu Chu (or Upper Salween River) is probably a section of the main range of Himālayas; in which case the Po Tsang Chu would not break through it at any point.

Unfortunately it was impossible to carry out that particular requirement of the Government of India to fix the main range east (or probably north) of the Tsan-po Gorge.

If, as has been suggested above, the range trends nearly due north from the gorge—and visual evidence was obtained at Phea Doshung to support this theory—and joins the mountains which divide Potodh, Pomed, and Poyul on the south from the valley of the Giama-Nu Chu on the north, it would not be possible to survey or even fix the direction of such a range approximately without entering Pomed.

This the Abor Exploration party was unable to do, even had time permitted, owing to an insufficiency of transport and escort.

As a net result of the surveys executed during 1912–13 it may fairly be claimed that the whole programme of survey for the Abor Exploration party as laid down by the Government of India has been practically accomplished.

During the Abor Expedition in 1911–12 a short series of triangulation, based on the side Nāri H.S. and Dutia P.S. of the Assam Valley (G.T.) series (Synoptical Vol. XXII.), was carried northwards over the outer range into the Dihāng Valley. Two stations of this series, Bapu h. s. and Torne h. s., are situated on the outer range; the other two terminal stations, Sadap h. s. and Namkam h. s., are situated in the lower portion of the Dihāng Valley in about the latitude of Kebang Village. Namkam h. s. is on the left bank of the Dihāng, on the southern end of the watershed between that river and the Yamne; the other three stations are on the right bank of the Dihāng River. When this series was computed during the summer of 1912 the figures were "ground down" roughly; the mean triangular error is 4·0 seconds and the mean linear error for four common sides is 1·8 in. per mile.

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even better. A fifth station Pangi h. s. was observed at in connection with the series, but the triangle Torne-Sadap-Pangi is a supplementary one and not part of the series.

North of the series five independent stations in the Dihāng Valley were observed from—Arte, Simong, Geku, Shumsing and Peram. They could not be connected with the series in the ordinary way and were computed by interpolation from some of the intersected points fixed from stations of the series.

Altogether 45 new intersected points were fixed during 1911–12.

In 1912–13 the series was considerably extended by the Abor Exploration party. Bapu h. s. was re-observed at and a new station, Kine h. s., situated on the outer range east of the Dihāng, was also established before the close of 1912. Kine was fixed by two triangles, one angle of each being unobserved. The observations were however made to opaque signals and the two values obtained for the side Kine-Bapu show a discrepancy of only 1·3 ft., or 0·9 in. per mile, so that Kine may be considered well fixed.

A plain's station was also fixed in December, 1912, at Pasighat, included in the series chiefly to provide an accurate point for the closing of traverses across the plains between the Brahmaputra and the outer range in future.

After the failure of an attempt, made in February, 1913, to extend the series northwards by establishing stations on the big spur at the head of the Yamne Valley, the series was eventually completed about the beginning of June, 1913, by observations made from three new stations west of the Dihāng River, Loyung h. s., Luyor h. s., and Dino h. s.

The first is situated on the right bank of the Dihāng near Bomo Village, the second on the Sike-Dihāng watershed, and the third on the right bank of the Dihāng near Pango Village.

Though all the angles of this triangle Loyung-Luyor-Dino were observed to signals, the triangular error being 3 seconds only, it was not possible to connect it with the two forward stations in the series of the previous season. The connection with the series had to be made as follows:—The side Kine-Loyung was obtained from triangles (with one angle of each unobserved) off five well-fixed intersected points. A mean of the values was taken giving a probable error of 12 ft., or 0·3 in. per mile. Off the *corrected* sides of the same five triangles the side Loyung-Dino was obtained, the mean of the five values giving a probable error of 5 ft., or 3·4 in. per mile. From this mean value of the side Loyung-Dino, the triangle Dino-Loyung-Luyor was computed, giving one value for the side Loyung-Luyor. Another value for this side was obtained, the mean giving a probable error of 10 ft. or 9·7 in. per mile.

These two values for the side Loyung-Luyor differed by 4 ft. only, or 3·8 in. per mile. The mean of these two values was accepted

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as the final base from which the triangle Loyung-Luyor-Dino was recomputed.

North of these three stations, but unconnected with them, an interpolation was made from several well-fixed intersected points at Nishing h. s., on the ridge of the same name near Geling Village, towards the end of June, 1913, to provide a few more intersected points for the plane-tablers. In addition one station with an auxiliary station near it was made at Miging Village in July, 1913, for the purpose of obtaining an accurate value of the height of the Dihāng River at its junction with the Sirapateng River (1,270 ft.).

As a result of the triangulation carried out in 1912–13 it has been decided to treat the five independent stations, Arte, Simong, Geku, Shumsing and Peram of 1911–12 merely as intersected points, and all work dependent on them has therefore been rejected. Many of the intersected points fixed in 1911–12, having been fixed more accurately in 1912–13, have also been recomputed.

The total number of intersected points which have been finally obtained from the triangulation of both seasons is 125.

No useful purpose would be served in working out a mean linear error for all these intersected points, as so many special factors which cause the errors to vary abnormally in any trans-frontier triangulation would have to be taken into consideration.

Errors in rays to sharply-defined snow peaks for instance are naturally less in proportion than in rays to rounded jungle-clad hills. The quality also of the northern portion of the series as triangulation is not, by nature of its connection, as good as the southern portion.

The most accurately fixed intersected points, viz., nine sharply-defined snow peaks, were computed in more detail than the rest because they were required for use in extending the triangulation.

These nine peaks should serve as well-fixed points from which an extension of the triangulation to the north and north-east could in future be made if necessary.

No connection has been made with the triangulation executed by the Mīri Mission Survey Detachment in 1911–12, or by the Dibāng Exploration party in 1912–13. Some of the peaks on a part of the Dihāng-Subansirī Watershed (the common margin) intersected from the Dihāng series appear to be identical with those fixed by the Mīri Mission triangulation, but there is sufficient discrepancy between the co-ordinates in nearly every case to affect the work of the plane-tabler considerably (even on the $\frac{1}{4}$-in. scale) if both sets of points are used indiscriminately.

A partial explanation of this discrepancy lies in the fact that, although both the Subansirī and Dihāng triangulation emanate from the same Assam Valley series, these identical peaks were observed from opposite sides of the watershed, different features on the same

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peak being observed to from either side. Another reason is the inferiority of the Subansirī series as compared with that in the Dihāng. The Subansirī series of 1911–12 was extended from Colonel Woodthorpe's stations of 1877–78, which are connected somewhat precariously with the Assam Valley series.

If therefore the Subansirī series is ever extended northwards without revision it is doubtful whether the intersected points of the Dihāng series on this watershed can be utilized for accurate theodolite interpolations in the Subansirī Valley unless some means can be devised to connect the two series and adjust the present discrepancies.

No identical points on the common margin the Dihāng-Dibāng watershed have been fixed by the Dihāng and Dibāng triangulation. Even had the same peak been fixed in any case from either side the discrepancy between the co-ordinates would be considerable, as the two series are not in the same terms and the basis of the Dibāng triangulation is unreliable.

During both seasons it proved a difficult and troublesome matter to arrive at a satisfactory coefficient of refraction. Seeing that even in the finest spells of weather in the Dihāng Basin all snow peaks and most of the lower hilltops are invariably hidden in cloud after 8 or 9 a.m., for the rest of the day, most vertical angle observations have to be taken in the early morning instead of at the time of minimum refraction. This may possibly account for the large discrepancies which have been experienced in working out this coefficient.

Eleven reciprocal values for heights were obtained in 1911–12; five of these were from the hills to the plains, but the mean coefficient for the remaining six values in the hills worked out to ·041.

Though this figure seemed too low it was adopted in the absence of any other more reliable data to work out the heights of all the intersected points fixed in 1911–12. However, as the triangulation of 1912–13 was extended northwards, disagreements in values for heights of the more distant intersected points indicated that this coefficient was too low and that the correct coefficient would probably be about ·060 or ·065.

As a result of all the triangulation of 1912–13 seven more reciprocal height values were obtained, six of which were in the hills. The mean coefficient for these six values worked out to ·079; and the mean of the twelve values of both seasons therefore gives a coefficient of ·060.

As however the Dibāng triangulation of 1912–13 had resulted in a mean coefficient of ·069 from 21 reciprocal height values, the matter was referred to the Superintendent of the Trigonometrical Survey who decided that the usual coefficient ·070 should be adopted. The heights of all the intersected points fixed in both seasons have been recomputed with this coefficient.

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5″ micrometer theodolites (by Troughton & Sims) were used both seasons. Though three khalasis are required to carry one of these instruments and its stand, this disadvantage is greatly outweighed by its superiority over a lighter vernier instrument, both in accuracy and the ease and quickness with which observations can be made.

Usually it was found quite sufficient to read only one horizontal and one vertical microscope, a great consideration on the North-East Frontier where speed in observing is all-essential owing to the limitations imposed by an extremely adverse climate.

The adjustment of the micrometers of these instruments is not affected by rough usage nearly as much as might be expected. It was only possible to use heliotropes at the one plain's station Dutia in 1911–12. Otherwise opaque signals of various types were used for all the remaining stations in both seasons; the best and most usual type of signal being a single tree left standing on all the jungle-covered hilltops, the other trees all round it being cut down.

Attempts were made on several occasions to build machans in big trees in order to save the heavy labour of clearing, but none of these attempts proved satisfactory. At two or three stations the top of a tree was cut off several feet above ground level, the stump being used as a stand for the theodolite with a rough machan built round it as a platform for the observers. This is the most satisfactory kind of machan, but skilled labour is required to remove the tree top at a sufficient height from the ground and to build a reasonably secure platform of that height.

The station marks have been cut on rocks *in situ* wherever possible; at some of the stations however the mark had to be cut on tree stumps and cannot therefore be relied on as permanent.

Mention has already been made of the extraordinarily dense vegetation which covers all the hills in the Dihāng River Basin right up to permanent snow level, and of the execrable climate, both of which offer the greatest impediments to triangulation and render hasty reconnaissance work impossible.

The heavy clearing which had to be undertaken in the preparation of every hill station, especially as the tops of the lower hills are usually flat rather than pointed, rendered it essential to select as few stations as possible, and a very large number of observations therefore had to be made at each station. The only weather suitable for triangulation is experienced between the middle of October and the middle of January. At any other time of year the triangulator must be prepared to wait several days on each hill station before one of the infrequent spells of fine weather occurs to make any work possible.

As also snow peaks and all the higher hills are only visible between dawn and 8 or 9 a.m. at all seasons of the year the triangulator must

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be encamped in the immediate vicinity of the station so that he can start work at dawn. Water is seldom found near the tops of hills below snow level so arrangements must be made for carrying it up to the camp on the hilltop. Canvas chagals are useful but wear out very quickly. Choongas made out of bamboos are excellent but not always obtainable. The best arrangement of all for Survey Detachments working on the North-East Frontier would be a light metal pakhal covered with rope netting to protect it from damage, of similar pattern to the regulation mule pakhal but designed to weigh not more than 60 lbs. when full, so that it could be carried by a coolie.

During the Abor Expedition of 1911–12 the total area plane-tabled on the scale of 4 miles to 1 inch amounted to about 2,300 square miles; of this total area however only about 1,730 square miles were more or less rigorously surveyed, the remaining 570 square miles consisting of approximate reconnaissance surveys by members of the detachment. Compilations of the sketches, reports, etc., submitted by the Intelligence and other officers of the Force have not been included in the above totals.

Owing principally to the impossibility of executing any triangulation until towards the close of the expedition, plane-tabling was carried out under great difficulties in an area devoid for the most part of triangulated points.

For this reason no contouring could be done, all hill features were shown by (horizontal) hill shading.

The following table shows the total out-turns of the individual members of the Abor Expedition Survey Detachment in 1911–12:—

Name.	Out-turn, sq. miles.	Approximate Number of Working Days.
Mr. Sher Jang, Khan Bahadur	1,431	50
Surveyor Hamid Gul	1,512	60
,, Abdul Majid	230	15
,, Abdur Rahim	345	25
,, Shah Muhammad	92	4

The large difference between the aggregate of these individual out-turns and the total area (2,300 square miles) surveyed is due to the unavoidable duplication of work caused, as on most military expeditions, by the inevitable subordination of survey considerations to military and political requirements.

The numbers of working days shown in the above table are only approximate; it is impossible to work out accurate totals expressed in complete working days put in by surveyors employed with military

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expeditions and exploration parties. As has been mentioned in a preceding paragraph practically the whole of the plane-tabling was accomplished in the last three months—January to March, 1912—before the Expedition returned to India.

Before the Abor Exploration party started work in 1912–13, the outline fair sheet of the previous season's work had been drawn and all the triangulation data had been computed. As the same area had to be covered again during the advance up the Dihāng Valley it was decided to contour the work of the previous season.

Blue prints on mounted drawing paper of the fair outline sheet were accordingly obtained and given to the surveyors of the Abor Exploration Survey Detachment to facilitate this work. These blue prints were attached to the plane-tables by a few strips of adhesive plaster, a small overlap of the print being first turned down all round the edge of the plane-table. This arrangement proved very satisfactory and resulted in very little distortion.

Except for the fringe of flat densely-forested country between the Brahmaputra and the outer range the whole area (about 2,000 square miles) surveyed in the previous season was thus contoured during 1912–13.

This entailed practically the re-survey of the whole of this area and incidentally disclosed the excellence of the work of Mr. Sher Jang and Surveyor Hamid Gul in 1911–12.

This work of contouring the lower portion of the Dihāng Basin was completed in the first half of the season 1912–13, while the extension northwards of the main line of communications was in progress. As the extension of the series of triangulation was also completed before the Exploration Party reached the unsurveyed area in the northern part of the Dihāng Basin, the plane-tablers were supplied with triangulated points before starting work in this area, and so were able to continue the work of contouring throughout the season.

The upper portions of two valleys only, the Sirapateng and the Doshung-Pemasiri, could not be accurately surveyed and contoured owing to the bad weather experienced while the surveyors were working in them. Reconnaissance surveys (based on prismatic compass traverses) could only be accomplished in these two cases, comprising a total area of 722 square miles. The area surveyed in detail and contoured in the remainder of the Dihāng Valley Basin during 1912–13, including the 2,000 square miles re-survey of the previous season's work, amounted to 5,478 square miles.

The total area surveyed in the Dihāng Basin during 1912–13 is therefore 6,200 square miles.

In addition a reconnaissance survey of about 140 square miles was executed by Surveyor Hamid Gul of the head-waters of the Siu Valley, a tributary of the Subansirī River.

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Thus the total out-turn of the plane-tabling in 1912–13 amounts to 6,340 square miles.

The following table shows the total out-turns of the individual members of the Abor Exploration Survey Detachment :—

Name.	Out-turn, sq. miles.	Approximate Number of Working Days
Capt. Trenchard, R.E.	239	10
,, Oakes, R.E.	328	10
Lieut. Huddleston, R.E.	400	15
Surveyor Hamid Gul	3,790	120
,, Bhamba Ram	1,333	50
,, Anwar Ali	250	20

At the close of the Abor Expedition rough outline and hill originals were prepared in Kobo while the detachment was awaiting demobilization orders at the beginning of April, 1912.

From these a provisional map of the surveys of 1911–12 was published in colours by the Map Publication Office towards the end of the same month.

By the end of September, 1912, all the computations had been finished and the outline sheet of the fair map was practically completed. (Blue prints of this outline sheet were used in 1912–13 for the re-survey and contouring of that area). The fair map of the Abor Expedition Surveys was not completed nor published however, as the Surveyor-General decided, when sanction for the operations of 1912–13 had been received, that publication should await the completion of surveys in that season.

Mention has already been made in para. 6 of this report of the explorations of Kinthup in the Dihāng Basin between 1881 and 1884.

As prominence has been given of late to the opinion of certain geographers that the geographical information which Kinthup supplied about the Dihāng Basin was merely collected by him in Tibet without visiting the Dihāng Valley and is therefore unreliable, this report seems a fit place to examine his work briefly in the light of the recent surveys carried out by the Abor Exploration party.

Firstly the accuracy of his names is very striking. In Pemakoi-chen and the Abor country he gives 57 names of which 34 fall within the area recently surveyed. Of these 34 names only 6 were not found ; two being names of camps or caves, one a village since deserted, while the other three might well be known now under different names. Of the remaining 23 names which Kinthup gives beyond the area recently surveyed all except three were confirmed

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by information obtained locally by the Political Officer in charge of the Abor Exploration party; two of the unverified names being those of caves and the third that of a pass.

Secondly, his description of the physical features of the different parts in which he travelled is remarkably correct. In the more intricate parts of this tangle of hills and winding rivers it was sometimes difficult to picture the topography from his account before actually visiting it, but, as a rule, it would be impossible to give a more accurate description in as few words.

Seeing that he was unable to keep a written record of his travels extending over a period of four years the accuracy of his account is remarkable. In the area recently surveyed he only appears to have made two geographical mistakes worth considering :—

(i.). Between Mobuk (or Gobuk) and Onlet (now known as Olon or Milang) Villages he mistook the Yamne Valley for that of the Dihāng.

(ii.). He stated that the river issuing from Sanga Chu Dzong joins the Tsan-po about 3 miles from Miri Padam.

As regards the first mistake anyone who has experienced days of continuous rain and mist among the intricate and often very deceptive hill features of the Abor country will realize how easy it is even for trained topographers to make such mistakes. Further it must be remembered that at this the most southerly point in his journey he was attempting to reach Assam and was following the direct trade route from Simong in the Dihāng Valley to Sadiyā when he was turned back by Padam Abors at Onlet (Olon or Milang) Village in the Yamne Valley. It is easy to understand how, after crossing the low saddle from Simong into the Yamne Valley he must have concluded that the river below him flowing south must be the same as the one he had just left. The second mistake appears to be the result of one of the few attempts he made to compile a topographical description from local information without actually visiting the ground. As this particular bit of information was obtained from Abors whose language he did not understand it is not surprising that he made this mistake. With these exceptions Kinthup made no serious mistakes.

Some of his critics, with the very insufficient knowledge of the Dihāng Basin obtained only in the Abor Expedition of 1911–12, have fastened on trifling details in his report in their attempts to prove that his whole account is purely imaginary.

One critic, for instance, maintained that there are no pine trees or apples in the Abor country as stated by Kinthup, and expressed his surprise that Kinthup should have omitted to mention Jido, a large Abor village near the junction of the Yang Sang Chu with the Dihāng.

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Kinthup may not have known the different varieties of conifers, or may have been wrongly translated. One variety, the cypress, flourishes in many parts of the Abor Hills, and with the crab apple (eaten by Abors) has been found in most of the localities described by Kinthup. Jido Village was not built until three years after Kinthup had returned to India.

In short the theory that he must have ascended some high mountain in Tibet overlooking the Dihāng Basin from which all the villages on the Dihāng were pointed out and described to him, and that he merely committed all these names, details of routes, etc., to memory without leaving Tibet is utterly ludicrous, specially when advanced by those who have themselves visited even a small portion of this Dihāng Basin.

His account has been confirmed in the most remarkable manner and we are now able to establish Kinthup's claim to honourable record in the annals of the Survey of India, which he served with such zeal and devotion to duty.

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The four views of the River Tsan-Po are from photographs by Captain F. M. Bailey, I.A., and are reproduced with his kind permission.

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View up stream from right bank of Tsan-po, near Kyikar village. These are the first rapids below Pe. Taken on 15th July, 1913.

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View of rapids on the Tsan-po, looking up stream from Nyuksang. Altitude 8,730. Taken on 20th July, 1913.

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Falls on Tsan-po, near Pemakoi-chen, from a point 100 ft. above the water on right bank. Altitude of top of Fall 8,380 ft. Height of Fall about 30 ft. Taken on 21st July, 1913.

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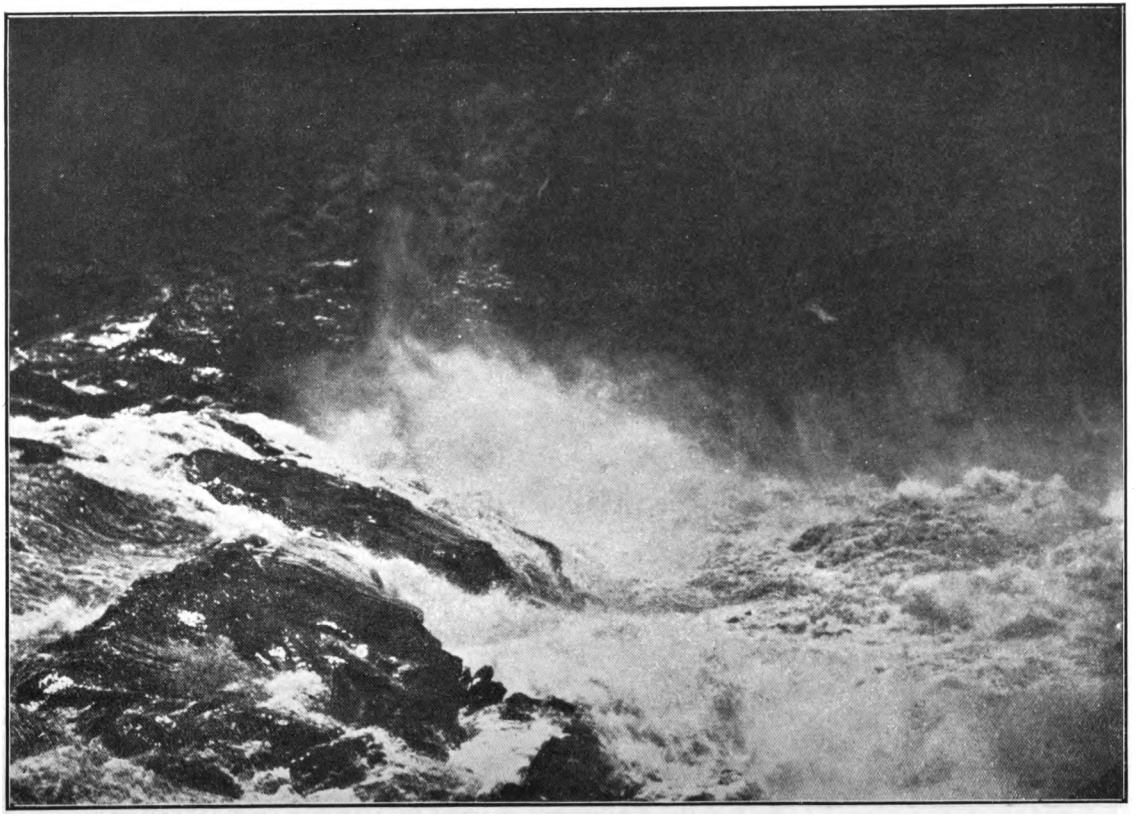

Falls on Tsan-po, near Pemakoi-chen, from water level on the right bank. Altitude 8,380 ft. Height of Fall about 30 ft. Taken on 21st July, 1913.

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ON IMPACT COEFFICIENTS FOR RAILWAY GIRDERS.

A PAPER was read by Mr. Chas. William Anderson, M.INST.C.E., at the Institution of Civil Engineers on the 13th ult. and by the courtesy of the Secretary we are enabled to publish the following abstract :—

The subject of the proper allowance to be made for the impact of moving loads is of especial interest at the present time to Indian railway administrations, in view of the extensive programmes which they have in hand for the replacing and strengthening of bridges.

The Indian Government Rules have recently been discussed and criticized, and the Indian Government desire to have the matter further ventilated by discussion. Finding that the Author had in view the submission to the Institution of a Paper on the subject, the Government placed at his disposal the data which they had collected in the shape of deflection and extensometer results.

The Paper is divided into six sections, the first of which recapitulates those of the Indian Government Rules which relate to the subject of impact, and describes their origin and development.

SECTION II.—*Standard Moving Loads.*—The Indian Rules lay down a standard uniform moving load to which all new or strengthened girders are to be designed. These loads are to be considered as static, and the allowance for impact is provided by a separate Rule, in contradistinction to the Board of Trade Rule, which leaves to the designer what proportion of the safe working stress he shall assign to the effect of impact.

In order to dissociate the consideration of the static and dynamic effects, the Author gives diagrams of the equivalent distributed loads for the engines and trains in actual or probable use on Indian railways, and arrives at the conclusion that in this respect the Indian Rules are not excessive in their demands.

SECTION III.—*The Safe Working Stress.*—The correctness of any rule for the co-efficient for impact cannot be discussed without first coming to a conclusion with regard to the safe working stress which is used in conjunction with it.

If it be accepted as axiomatic that the elastic limit of the material should never be passed, what has the margin of 8 tons per square inch to cover ?

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It has to provide for—

(*a*). Accidental defects in the material.
(*b*). Initial stresses in the material due to rolling.
(*c*). Stresses due to variation in temperature.
(*d*). Loss of section by corrosion.
(*e*). Faulty workmanship.
(*f*). Secondary stresses due to eccentric loading.

Taking all these probable causes of increase of actual as compared with calculated stresses into consideration, it does not appear that the nominal unit stress of 8 tons per square inch could be increased with advantage.

SECTION IV.—*Impact Formulas.*—All impact formulas are derived from Wöhler's experiments, followed by Bauschinger, Baker and others. Launhardt and Weyrauch deduced formulas from these. Mr. E. H. Stone has proposed a formula which expresses the ultimate effect of the moving load, building up his theory from the ratio which that load bears to the *total* load.

The Pencoyd formula as used by the Government of India depends more upon *span* than upon *range of stress*, thus differing from Stone's range rule.

The effects of the use of the various formulas are shown in diagrams.

SECTION V.—*The Evidence of the Immediate Effect of Moving Loads.*—(*a*). *By Calculation.*—One of the principal causes of increased stress, especially on small spans, is the periodical shifting of the weight due to the lurching of the engine. Variation of pressure is caused by centrifugal force set up by unbalanced parts or by excess vertical action of balance weights. An engine in use on the Bengal-Nagpur Railway is chosen for illustration, and increase of stress for spans of 5 ft. to 308 ft. is calculated for bending moments, shears and cross girders.

In addition, the causes of increased stress are—

(1). The effect of the velocity with which the load is applied.
(2). The effect of shocks caused by flat wheels, etc.
(3). The side pressure of the wheel flanges against the rails.
(4). Wind pressure on one rail.
(5). Coincidence of period of vibration.
(6). Curved trajectory of the moving load.

(*b*). *Experimental Evidence.*—Extensometer results of Messrs. La Touche and Sales, and Professor Turneaure, and deflection observations of the Government inspectors are plotted and examined in comparison with each other and with the Indian Government Rules.

SECTION VI.—*The Evidence of the Cumulative Effect of Moving Loads.*—The condition of 350 wrought-iron girders on the North Western Railway is shown in appendices detailing the result of tests

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of the material, and also in a drawing of a girder tested to destruction. After 30 years' use the girders had lost camber and showed loose rivets, and tests of the material indicated extreme brittleness.

The Lansdowne bridge, on the North Western Railway, after 24 years' use, has a large number of loose rivets. The stresses and typical joints are in illustrations. Corroborative evidence is given in a typical girder on the Bengal-Nagpur Railway.

General Conclusions.—Considering the sources of stress dealt with in Section III., and the evidences of the immediate effect of the moving load, the Author concludes that the minimum increment which should be allowed to the moving load is that which may be calculated by the formula—

$$I=\frac{50}{50+L}S \text{ as against the Government rule } I=\frac{300}{300+L}S.$$

This formula is suggested as a basis for discussion, as a suitable rule for use in connection with existing girders. For cross girders and rail-bearers even the Government rule is, if anything, too small.

For new girders intended to last indefinitely, it is doubtful whether the suggested formula is sufficient when taken in conjunction with the working stress of 8 tons per square inch.

Weight of Girders.—The weights of main girders to the existing rules, the modified rule $I=\frac{50}{50+L}$, and the Board of Trade Rules are calculated and compared.

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REVIEW.

WHAT EVERY SOLDIER OUGHT TO KNOW.

(Humphrey Milford, Oxford University Press. Amen Corner, London, E.C.).

THIS little work consists mainly of extracts taken (by permission of the War Office) from official text-books and training manuals, and is an attempt to provide the private soldier with as much knowledge of his profession as may conveniently be conveyed in print and in the smallest possible compass. Care has been taken to preserve the spirit as well as the letter of the authorized books of instruction. The text-books, etc., from which the information has been derived include The King's Regulations, Manual of Military Law, Field Service Regulations, Field Service Pocket Book, Manual of Field Engineering, Manual of Map Reading, R.A.M.C. Training, and the Manual of Military Hygiene, so it is very comprehensive. It is principally intended for the use of N.C.O.'s and men, is of a handy size, $2\frac{3}{4} \times 4\frac{3}{4}$ in., and the price is twopence.

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SOME FORMULÆ FOR THE BENDING OF BEAMS.

By 2ND LIEUT. C. McG. URE, 75TH (FIELD) CO., R.E.

THE author has found the formulæ given below more easy to memorize and use, and of wider application than those in general use. Besides the maximum stress allowable for the material used, which has to be known at any rate for use in problems other than those involving bending, the only things to be remembered are the general form of the equation, and four constants for the four common types of section dealt with.

b = breadth in inches.
d = depth in inches or diameter in inches.
t = thickness in inches.
w = uniformly distributed load in lbs. per foot-run.
F = maximum allowable stress in lbs. per square inch.
M = bending moment in inch-lbs.

Section.		A.	B.
1. Rectangular		$bd^2 = \frac{9}{F} wl^2$	$= \frac{2}{3} \times \frac{9}{F} M.$
2. Circular		$d^3 = \frac{15}{F} wl^2$	$= \frac{2}{3} \times \frac{15}{F} M.$
3. Tubular		$td^2 = \frac{1}{F} wl^2$	$= \frac{2}{3} \times \frac{1}{F} M.$
4. I form		$bd^2 = \frac{27}{F} wl^2$	$= \frac{2}{3} \times \frac{27}{F} M.$

In Table "A" w and F may be in any weight units, so long as they agree. *E.g.* w may be in cwts. per foot-run, and F in cwts. per square inch.

Table "B" has been compiled for use with the graphs at the end of Part IIIA., *Military Engineering.*

Formula No. 1 is mathematically correct.

Formulas 2 and 3 have an error of about 5 per cent. on the safe side. No. 3 formula only applies when t is small compared with d. d is the mean diameter of the tube.

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Formula No. 4 is necessarily approximate, as the thickness of web and flanges are not considered. These are, however, in all ordinary joists proportional to the size of the joist. The formula will be found to give good approximate results, and is more suited for hasty work and use by N.C.O.'s, than more exact methods involving the determination of a moment of inertia.

EXAMPLES.

(1). *Formula* 3, *Table* "*A*."—Cast-iron pipes, diameter 6 in., thickness $\frac{1}{4}$ in., are to be used as girders to take a load of 3 cwt. per foot run. Find maximum safe unsupported length. F=40 cwt. per square inch say.

$$\frac{1}{4} \times 36 = \frac{15}{40} \times 3 \times l^2.$$

$$\therefore l^2 = \frac{40 \times 36}{4 \times 15 \times 3} = \frac{72}{9}.$$

$$\therefore l = 2' \ 10''.$$

(2). *Formula* 2, *Table* "*B*."—Fir logs, mean diameter 10 in., are available to bridge a span of 14 ft., the bridge to carry 4·7 B.L. guns. How many logs are required? F=1,200 lbs. per square inch say.

$$1{,}000 = \frac{15}{1{,}200} \times \tfrac{2}{3} \text{M}.$$

$$\text{M} = \frac{1{,}000 \times 1{,}200 \times 3}{2 \times 15} = 120{,}000.$$

I.e. B.M. on one roadbearer must not exceed 120,000 inch-lbs.

From *Plate* VII., Part IIIA., *Military Engineering*, total M_{fff}=680,000 inch-lbs.

$\therefore$ *We must have 7 roadbearers.*

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DELHI CORONATION DURBAR.

THE following is a continuation of the Reports which have already appeared in the *R.E. Journal*, throughout 1914, of the Work carried out by the Military Works Services at the Durbar.

ELECTRICAL WORK.

INTRODUCTION.

On the occasion of the Coronation Durbar held in Delhi during December, 1911, by Their Imperial Majesties the King Emperor and the Queen Empress, the Director-General Military Works was asked to undertake the electric lighting of Delhi Fort and of the camps of His Excellency the Commander-in-Chief and of Army Headquarters. In the former case a complete installation inclusive of power plant was required, but in the case of the camps the work included only the distribution within the camp areas, the necessary power being available from the Royal Durbar Electricity Works.

THE FORT INSTALLATION.

General Description.—The Royal Garden Party was held by Their Imperial Majesties in the fort at Delhi on December 13th, 1911, and for this special occasion the palace buildings and gardens and the roads of approach from the Delhi and Lahore Gates and from Selimgarh were lighted electrically, while the walls of the fort and the cupolas of the above two main gates were illuminated with *Chiraghs*.

Power.—Electric power for the above purpose was obtained from the Military Works Power Station in Delhi Fort, which had been just completed for the supply of power for the ventilation and lighting of the barracks and for wireless telegraphy. The plant installed consisted of two 30-k.w. 220—240 volt Campbell oil engine sets and a 30-k.w. battery, only one set and the battery however being employed at any one time for the actual lighting.

Distribution.—The distribution of power, except in the palace gardens, was through bare aerial copper wire on the 2-wire system; the palace buildings and gardens lying along the east wall of the fort were supplied from a main running along the *bela* close under this wall, while the remaining distributing lines throughout the fort were concealed from the palace as far as possible by trees.

Within the gardens power was distributed from tree to tree through flexible covered copper wire, and the buildings themselves were wired with flexible wire throughout.

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Details of Exterior Lighting.—The details of the lighting were as follows :—

(*a*). The approach roads from the Delhi Gate and Selimgarh were lighted with 25-C.P. incandescent lamps set in white shades on specially designed posts 20 yards apart, on either side of the road ; the Lahore Gate was lighted with one 100-C.P. lamp at each end of the outer gate, one 100-C.P. lamp over the outside of the great arch of the inner gate and one in the dome within it, and the arcade beyond was lighted by plain unshaded 25-C.P. lamps suspended above every other archway in the arcade from wooden brackets carved and painted to resemble the stone, and fixed to the parapet walls of the upper line of openings on either side of the roadway.

(*b*). The space between this gate and the Nabat Khana was brightly illuminated by eight 200-C.P. lamps in opal globes suspended 15 ft. above the ground from ornamental brackets supported on square wooden pillars of a pattern in keeping with the surroundings.

(*c*). The courtyard between the Nabat Khana and the Dewan-i-Am was lighted by these similar fittings equally spread over each side of this area.

(*d*). The gardens beyond the Dewan-i-Am were entirely lighted from the buildings, and by plain unshaded 25-C.P. lamps suspended in the trees.

Details of Interior Lighting.—The lighting of the palace buildings was effected by means of fittings specially designed to be in keeping with the architecture, with the exception of the Dewan-i-Am, Dewan-i-Khas, the Moti-Masjid and Zafar-Mahal. These fittings consisted of pendants and standards arranged to throw the light upwards and were in the form of a large Chiragh with a flame-shaped globe which for 25 and 50-C.P. lamps were of glass and for 100-C.P. lamps of silk. The pendants were suspended either from the ceiling or from specially designed brackets of curbed wrought iron, painted white.

(*b*). The Dewan-i-Am was unlighted except for brilliant concealed lighting in and around the white marble throne, the reflected light of which diffused the whole building with effective and subdued light.

(*c*). The Dewan-i-Khas was illuminated by 25-C.P. lamps concealed in a tin trough fixed to the cornice and painted to blend with the marble.

(*d*). The Moti-Masjid was brilliantly illuminated by a row of 25-C.P. lamps in front of a tin reflector concealed as far as possible and so arranged as to light up the interior as seen from the door and windows ; one 25-C.P. lamp was also placed in each cupola, and proved one of the most effective illuminations in the palace.

(*e*). The lighting of the Zafar-Mahal was restricted to illuminating

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the interior by two unshaded 25-C.P. lamps in each corner room of the building.

(*f*). The refreshment Shamianas were lighted from pendants fitted with empire pattern shades of white, cream, red or yellow crinkled paper.

(*g*). Besides the above, electric lights varying from 50 to 100-C.P. were concealed in the cupolas on the roofs of all the palace buildings and 8-C.P. lamps, wired with lead-covered cable and protected from the falling water by glass, were fitted in the niches behind the cascades of Bawan and Bhadon.

Searchlights.—Two searchlights which added considerably to the general effect were placed on the roofs of two of the barracks.

Chiraghs.—The walls of the fort and the upper parts of the Delhi and Lahore Gates were illuminated by Chiraghs.

THE CAMP INSTALLATIONS.

General.—The lighting carried out in the camps of His Excellency the Commander-in-Chief and of Army Headquarters included the distribution within the camp areas and the lighting of the tents and of the roads within the camps.

Power.—Power for this purpose was obtained by 3-wire at a pressure of 440 volts across the outers from the mains of the Royal Durbar Electrical Installation, at points on the perimeters of the camps fixed by the staff of that service, these points being, in the case of the Commander-in-Chief's camp a buried main at the S.W. corner of the camp only, and in the case of the Army Headquarters camp an aerial main running along its front.

(*b*). Before connections with these mains could be made by the above staff, the whole installation to be connected was required to be provided with D.P. main fuzes, and to pass the following installation test. With all camps and appliances removed from the circuit and all switches and fuzes on, a pressure of 500 volts being applied, the insulation resistance between poles to be not less in megohms than 25 divided by the number of pairs of terminals from which a supply of energy would be taken.

(*c*). Besides the above tests the Durbar Committee laid down a proviso that no aerial wiring was to be within 75 ft. of the Processional Road, and this entailed a short length of buried cable within the area of the Commander-in-Chief's camp.

Distribution.—With the above exception and except in case of a few short 2-wire services where covered wire, supported on the tents, was used, and in the case of street lighting, the distribution throughout the camp was through bare aerial copper wire, on the 3-wire system, supported on three sections of Indian Telegraph Department Hamilton pattern poles.

(*b*). In order to localize faults the distributing system in each camp was divided into areas each supplied by one distributor, the

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Commander-in-Chief's camp having four and the Army Headquarters camp two, and each distributor was equipped with a D.P. fuze and D.P. switch placed on a pole as near the main feeding point as possible.

(*c*). The routes followed by these distributing lines were duly laid according to plans. In the camp of His Excellency the Commander-in-Chief a considerable detour had to be made to the east side of the camp in order to avoid spoiling the main vista by taking aerial wires across it, but thanks to the use of large copper in the distributor and to the employment of metallic filament lamps the loss of voltage to the lamp furthest from the feeding point was not noticeably felt.

External Lighting.—In the external lighting of the camp areas, except on the two main gates of the Commander-in-Chief's camp, for which wrought-iron and copper lamps were specially designed, no water-tight fittings were fitted. All other external lights were fitted with ordinary holders and opal or enamelled iron shades, fixed to plain brass 3-in. tubular brackets, screwed to posts, trees, or bound with wire to the poles of the distributing lines.

(*b*). For the lighting of the main roads of the Commander-in-Chief's camp 50-C.P. lamps on posts similar to those used in the fort were installed from 30 yards to 40 yards apart on either side of the road, power being supplied through ordinary 600-megohm grade vulcanized 1/18 cable buried 6 in. in the ground.

Interior Lighting.—In the lighting of the tents the lamps and switches were placed in each case as far as possible to suit the particular purpose for which they were installed. The switches were sewn direct on to the stiffening pieces of the *kanats*, and the lamps were similarly fixed or suspended from the inner fly. Except that 50-C.P. lamps were installed in the drawing room, dining room, and study of His Excellency's own tents and in the ante-room of the Army Headquarter Mess, and 8-C.P. carbon filament lamps were used in all bathrooms, the lamps used throughout were 25-C.P. metallic filament.

(*b*). For the wiring of the tents 600-megohm grade vulcanized 1/18 or 3/22 wire was used, the wires lying loose on the top of the inner flies, or sewn to the *kanats* with thread.

(*c*). The connections were made direct from the overhead bare copper, the neutral being taken direct to the nearest lamp and the outer to a cut-out, fitted except in a few cases with 1 ampère fuze wire, fixed on to one of the ropes outside the tent. The joints in the wiring were insulated with black tape only and not soldered.

(*d*). In His Excellency's State tents silk shades made on the spot were used, and shades of crinkled paper were installed in all the drawing-room tents of the guests in both camps, some 300 being specially made in the camp by an expert shade-maker brought down from Simla. In other cases glass, opal, or enamelled iron shades

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were used according to the situation. A few table lamps were installed in special cases.

STORES.

External.—The external wiring of the fort and camps was carried out with stores from stock purchased for use at Cawnpore and elsewhere but never installed.

The buried mains referred to in para. 10 (*c*) above consisted of three 50-yard lengths of 19/15 lead-covered cable and were obtained on loan from the spare stores of the Bombay Defence Light Section.

Internal.—For internal wiring a small quantity of material such as switches, cut-outs, enamelled iron shades and table lamps were available from the Roorkee stock mentioned above, but all the lamps, special fittings, and a large part of the covered wire had to be purchased for the occasion. A share of such part of the stores specially purchased as could eventually be used in barrack installations was charged to stock, while the remainder was charged off direct to the service for which it was obtained.

Fittings.—A considerable quantity of the fittings, particularly for the fort, were specially designed for the occasion and made up in Simla and in the workshops at Roorkee.

Searchlights.—The two searchlight projectors, complete with lamps, etc., and a short length of cable each, were obtained on loan from the spare plant of the Bombay Defences Light Section; one of the boilers was borrowed from the surplus Ahmednagar Water Supply plant, and the other with an engine was taken over for eventual use in the Roorkee shops from the Balloon Section of the 1st Sappers & Miners. The second engine and the two dynamos were obtained on loan from Roorkee.

Lamps.—The lamps used throughout the fort and camps, except the few 8-C.P. carbon filament lamps already detailed, were of the metallic filament type of Ediswan and Tantalum makes, obtained on payment through the Royal Durbar Electrical Engineer.

The approximate numbers of lamps in use were as follows :—

	200 C.P.	100 C.P.	50 C.P.	25 C.P.	8 C.P.	Total.
Fort	14	36	40	1000	50	1140
C-in-C.'s Camp . . .	—	4	88	331	97	560
Army Headquarter Camp .	—	—	6	299	—	305

PERSONNEL.

Personnel.—The above work was carried out with Indian labour, collected from the Punjab, under the supervision of Capt. L. N. Malan, R.E., on behalf of the Director-General Military Works, and

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of Mr. T. J. H. Blackley, Electrical Engineer in Charge M.W.S. Workshops at Roorkee. Capt. Malan executed the work in the camps and supervised generally, while Mr. Blackley was in charge of all work in the fort, assisted in the erection of the two searchlights by Corpl. Fettes, R.E., and Sapper Easthope, R.E., both of the Calcutta Defence Light Section, 1st Sappers & Miners.

TIME.

Time.—The erection of the fort installation was commenced under Mr. Blackley early in September and was completed by the beginning of December.

The erection of the overhead wiring in the Commander-in-Chief's camp was begun by the *mistries* on September 30th, the work being periodically visited from Simla by Capt. Malan who was finally relieved and arrived in Delhi on the 29th October. The internal wiring was commenced at once and lights given in the tents of the camp staff. Half of Army Headquarter camp was completed on November 15th and the remainder on the 25th. His Excellency the Commander-in-Chief's own tents were completed on the 18th November and the whole camp was finished on the 28th.

COST.

Cost.—The estimates and designs for the above work were prepared in the office of the Director-General Military Works and the expenditure was as follows :—

	Estimate.	Expenditure.			Excess or Saving.		
	£	£	s.	d.	£	s.	d.
Fort	9,180	12,140	9	9	+ 2,960	9	9
C.-in-C.'s Camp . . .	5,297	4,742	0	0	− 555	0	0
Do. Daughter's Camp .	220	220	0	0	—		
Army Headquarters Camp . .	2,500	3,030	3	1	+ 530	3	1
Army Headquarters Daughter's Camp	220	220	0	0	—		
VIII. Divisional Headquarters, supply of TableLamps only .	30	30	0	0	—		
	17,447	20,382	12	10	+ 2,935	12	10

(*b*). The causes of the excesses on the fort and Army Headquarters camp installations were :—

(i.). *Fort.*—Incandescent lamps were substituted for arc lamps at the request of the Durbar Committee, who also required a considerable number of extra lamps in the refreshment Shamianas in the sally port, etc., which were not estimated for. A severe storm towards the end of November, when most of the lights in the trees were fixed, caused considerable damage, and no allowance had been

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made in the estimate, as storms of such magnitude are abnormal in Delhi at that time of year.

The Durbar Committee moreover demanded more *Chiragh* illumination than was estimated for and this caused extra expense.

(ii.). *Army Headquarter Camp.*—A number of extra tents were pitched in this camp, in excess of those for which provision was asked in the first instance and for which lights were allowed in the estimate. At the request of the officer in charge lights were installed in these extra tents, and he was informed at the time that the estimate would in all probability be exceeded thereby.

(*c*). The saving on the Commander-in-Chief's camp is due to fewer lights being installed than was estimated for.

Notes for Future Guidance.

The following points, brought to notice during the execution of the works detailed in this report, are noted for the guidance of those who may in the future be called upon to undertake similar work.

As economy was the keynote of the work undertaken everything possible was done to reduce the cost and in consequence difficulties were incurred.

Overhead Mains.—As there was a large quantity of heavy copper wire on stock it had to be utilized and this took longer and cost more to erect than would have been the case had wire of the sizes actually necessary been forthcoming. In the absence of sockets and sole plates of suitable sizes on stock, poles were erected without them ; this was a mistake as the heavy (and unexpected) rain about the middle of November softened the ground, with the result that some of the poles were pulled out of the perpendicular by the weight of the wires, and although this did not affect the service it was unsightly. To economize further and in the absence of sufficient proper insulator brackets, the special 4-wire angle-iron arms made for Cawnpore at Roorkee were used. These arms being fitted without their proper struts which were not obtainable, did not in all cases prove equal to the strain put upon them. It is recommended that in future these be made of channel iron and never used without the struts.

Buried Wires.—The lead-covered cables obtained from Bombay for the main connection to the Commander-in-Chief's camp were evidently old and perished, although never used, as they failed on the first day of heavy supply.

(*b*). The 1/18 600-megohm grade ordinary vulcanized wire used for street lighting stood being buried in damp soil very well. These wires were however only buried 6 in. and this did not prove sufficient as in several places they were broken by the camp workmen when planting cress or fitting the tile edging to the paths and roads. These wires should have been buried at least one foot deep.

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Internal Wiring.—The internal wiring proved successful and calls for no remark, except that it is essential that the cut-outs shall be of a pattern in which an arc is an impossibility and that they should be placed at least 2 ft. away from any inflammable material. As it happened on one occasion an accident on one of the Durbar mains put for a short time nearly the whole of the 440-volt pressure between one of the outers and the neutral in the Commander-in-Chief's camp. This caused a number of the cut-outs in the camp to arc badly for some seconds and so fuzed and destroyed a large number of lamps, besides causing considerable alarm to the guests in the camp.

Lamps.—The metallic filament lamps employed although exceedingly efficient and as far as the light given is concerned satisfactory, are very fragile. So long as they are treated with reasonable care they are suitable for tent lighting but should only be suspended in trees when the absence of high wind and storms is assured, as the severe storm in November caused very heavy loss of lamps in the trees of the palace gardens in the fort.

Stores.—Owing to the want of proper storage accommodation in the camps (due to a false economy) a certain amount of stores, particularly copper wire, was stolen or otherwise disappeared. On a future occasion it is recommended that a lock-up store be provided with a responsible clerk in charge; the extra cost would be repaid.

Labour.—The chief and greatest source of all the troubles that were encountered was the labour. In the first place, with but very few exceptions the *mistries* imported from the Punjab were most unsatisfactory and troublesome. No reliance could be placed upon the majority of them, which entailed very heavy work on the officers in charge, particularly in the camps. The want of a reliable subordinate in charge of each camp was badly felt, but the meagre allotments given for these services were not sufficient to enable even one to be employed. It is strongly recommended that, on any similar future occasion, the European staff be not too much cut down as in this case.

Time.—The time allotted in the first instance proved only just sufficient, but it would have been ample had the original programme, on which the estimate was based, been adhered to. Both the Commander-in-Chief's and Army Headquarters Camps were however occupied, at least in part, over two weeks before the date originally intended, and this put a considerable extra strain on all concerned in their preparation.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE DEFENCE OF LUCKNOW, MAY—NOVEMBER, 1857.

The first practical intimation that the contagion of the cartridge question had reached Oudh was manifested early in April. Here it is necessary to state the troops by whom the newly annexed province was garrisoned. At Lucknow itself were quartered H.M.'s 32nd Regiment about 700 strong; a weak company of European Artillery; the 7th Regiment Light Cavalry (native); the 13th, 48th, and 71st Regiments of Native Infantry. Besides these there were at Lucknow, or in its immediate environs, two regiments of Irregular Native Infantry, raised for local service in Oudh, the 4th, and the 7th; one regiment of Military Police, the 3rd; a large proportion of Mounted Military Police;* one regiment of Oudh Irregular Cavalry; and two batteries of Native Artillery. Thus the native armed troops were in the proportion of nearly ten to one Europeans, the actual numbers being 7,000 to 750. At Sitápúr, in addition to local troops, the 41st Native Infantry was stationed having a detachment at Malaun; at Sultánpúr, the 15th Irregular Cavalry. The other stations, Daryábád, Faizábád, and Bahraich, were garrisoned by local corps.

On the 20th March, 1857, Sir Henry Lawrence had assumed the Chief Commissionership of Lucknow. Of all the men who have ever attained a prominent position in India, Sir Henry Lawrence was, perhaps, the most qualified to remove a discontent engendered by action—too fast, too hard, too reckless—on the part of the Government. He had great sympathies with the people, and thoroughly understood them. He did not, however, confine himself solely to the work of pacifying and of reasoning with the people. He realized at a glance the danger that threatened India; he felt that at any moment the handful of Englishmen in the country might have two hundred millions on their hands. Whilst then he used every per-

* The Oudh Military Police consisted of 1,000 cavalry and 3 regiments of infantry, commanded by Capt. Gould Weston, an officer of great ability, who, prior to the annexation of the province, had been engaged for some years in the suppression of Thagí and Dakaití.

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suasive argument, and put into action every precautionary measure to avert a crisis, he prepared to meet one.

He began his preparations in April. His own headquarters were at the Residency situated in the city close to the river Gúmti, and upwards of a quarter of a mile from the iron bridge leading to the Mariáun Cantonment. The native infantry regiments, a light horse battery of European artillery, and a battery of native artillery were at Mariáum. At Múdkipúr, 1½ miles further still from the Residency, was one cavalry regiment. In an opposite direction, in a line in fact forming a right angle with the road to Mariáun and at a distance of 1½ miles from the point of the angle, the Residency, was H.M.'s 32nd Regiment about 700 strong. Nearly 1½ miles directly north of the barracks of the British Regiment, and on the opposite bank of the river Gúmti, was the only remaining regiment of native cavalry. South of the river again, at or near Músa Bágh, 3 miles from the Residency, were two irregular native regiments, and between them and the Residency was a magazine containing a considerable stand of arms. About the Residency itself were clustered several substantial buildings of solid masonry occupied by the higher European officials. Here also were the Treasury, the Hospital, and a gaol. A detachment of native troops guarded the Residency and the Treasury. The whole of the Residency buildings were known to the natives throughout Oudh by the name Baillie Guard.*

Rather less than 1 mile from the Residency, on the same side of the river Gúmti, is a castellated stronghold called the Machchí Bhawan. The attention of Sir Henry was, in the first instance, directed to making the Residency defensible, and to a better location of the British troops. With this end in view he began to clear away the huts and other obstructions which occupied the ground close to the Residency; to lay in supplies of grain of all sorts, and European stores; to accumulate powder and small-arm ammunition and to dig pits for their reception; to arrange for a constant water supply; by degrees to send for the treasure from the city and outlying station; and to form outworks on the ground encompassing the Residency. At the same time he moved to the vicinity of the barracks of the 32nd Foot four guns of the native battery stationed at Mariáun. His preparations had not been made too soon. On the 30th April the storm threatened. On the 3rd of May it broke.

The 7th Regiment of Oudh Irregular Infantry was stationed at Músa Bagh, about 3 miles from the Residency. The adjutant of the regiment was Lieut. Mecham, a cool, determined, and reso-

* The guard in question commanded by a Subadar was first stationed at this gate by Colonel Baillie, a former resident at the Court of Oudh. Hence the name.

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lute officer. On the 30th April when he took his men to ball practice, these suddenly showed a disinclination to use the new cartridge. Mecham pointed out to them that the cartridge was similar to that they had been using the previous fortnight. This seemed to satisfy the men, and they proceeded with the practice. But the next morning the sergeant-major reported that the men positively refused to bite the cartridge, that many even declined to receive or even to touch it.

The day following was spent by the men in brooding over their grievances. They worked themselves to the state of fanaticism which will not bear reason, and at 10 o'clock, on the 3rd, they had arrived at the conclusion that they must kill their European officers. The latter warned in time by the quartermaster-sergeant of the disposition of their men, nobly did their duty, and succeeded after a time in inducing the Sepoys to return to their lines, though they refused to surrender their arms.

But Sir Henry Lawrence was not content with this doubtful triumph. The men of the 7th were paraded. The question was put to them whether they would continue to bite the cartridge, or whether they would refuse. The men, after some hesitation, promised to obey, but their manner was so sullen and so insolent that Sir Henry felt he could not trust them. He at once proceeded to the spot with the force he had organized, consisting of the 32nd Foot, a European battery, three regular native regiments of infantry, and one of cavalry. It was dark, but Sir Henry at once brought the 7th to the front, and ordered them to lay down their arms. In the presence of the imposing force in their front and on their flanks and of the lighted port-fires of the gunners the courage of the mutinous Sepoys gave way. Many of them panic-stricken fled wildly from the spot, but, on being followed and assured that no violence would be used if they obeyed orders, they returned, and before midnight all their arms were secured.

The next day the ringleaders were seized, and it transpired from their admissions that a treasonable correspondence with the view to a general rising had been going on for some time between them and the men of the 48th Regiment of Native Infantry.

On May 12th Sir Henry Lawrence held a great Durbar to which the native aristocracy, the European and native civil officials, the European and native officers were invited. Sir Henry concluded an eloquent speech delivered in the native language, by warning his listeners against becoming the dupes of designing men, and of the fate which would inevitably follow the neglect of his advice. He then caused the deserving native officers to be brought up to him, and in the name of the Government delivered to them the rewards they had merited.

The city of Lucknow 42 miles distant from Cawnpore extends

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for about 3 miles on the right bank of the river Gúmtí. All the principal palatial buildings, the Residency, and the Machchí Bawun are between the city and the river bank. South of these buildings and covering an immense space is the city. This is intersected by a canal which falls into the Gúmtí close to the Martinieré College, about 3 miles south-east of the Residency. A little to the south of this is the Dilkushá, a hunting-box or palace within an enclosed park. The space between the Residency and the Martinieré was occupied by palaces among which the Motí Mahal, the Shah-Munzil, the Sikandrabágh are the most conspicuous. South of the city, about 4 miles from the Residency on the southern side of the road leading to Cawnpore, is the Alumbágh, a large walled garden, with a high and pretentious gateway.

Not counting the position of the native cavalry at Múdkipún, Sir Henry possessed now three military posts. Two of these, the Residency and the Machchí Bawun, he made as strong as he could. Having regard to possible eventualities he removed the spare ammunition from the magazine into the Machchí Bawun. He seized the earliest opportunity of garrisoning that place with Europeans, of storing supplies there, and of mounting on the ramparts guns of all sorts. Many of these were taken from the King's palaces, and were useful only to make a show. In the Residency compound, over the Treasury, he posted a mixed guard of 200 Sepoys, 130 Europeans and 6 guns—the guns being placed so that at the first alarm they could be brought to bear on any mutineers. The third post was the old cantonment of Mariáun. It was garrisoned by 340 men of the 32nd Foot, 50 European artillerymen, and 6 guns; the three native regiments, and a battery of native artillery. Here, Sir Henry, for the time, took up his quarters.

Having made these preparations, Sir Henry Lawrence took an early opportunity to move the ladies and children into the houses within the Residency enclosure. Here also were brought the families and the sick men of the 32nd Regiment. At the same time, the clerks, copyists, section-writers, and others of that class were armed and drilled. On the 27th May he was able to write to Lord Canning, "Both the Residency and the Machchí Bawun are safe against all probable comers." On the same day, Capt. Hutchinson (afterwards Major-General Hutchinson, C.B., C.S.I.), of the Engineers, Military Secretary to the Chief Commissioner, an officer of great talent and daring, was ordered by Sir Henry Lawrence to accompany into the district, as political officer, a column composed of 200 men of the 7th Cavalry, and 200 men of the 48th Native Infantry. The object of sending this column was to rid Lucknow of the presence of men who might then be dangerous, but who posted on the northern frontier of Oudh, might be employed with advantage to restrain the turbulence of the inhabitants. Marching from Lucknow on the 27th,

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the column reached Sandila, 32 miles to the westward of Lucknow, on the 1st of June. There Hutchinson received accounts of the mutiny of the 30th May at Lucknow. The Sepoys heard of it at the same time, and it at once became apparent that they were biding their time. Hutchinson, after vainly endeavouring to pacify them, and noting the increased insolence of the men, urged the officers not to allow themselves to be taken in the net which was preparing for them on the other side of the river Ganges. But they were deaf and would not hear him. The regiment crossed the sacred stream. On the 7th or 8th the men rose, massacred all their own officers but one, Lieut. Boulton, who fled to perish elsewhere, and went off to Delhi. Hutchinson, accompanied by the paymaster of pensioners, Major Mariott, who with him had declined to cross the river, returned in safety to Lucknow.

The precautions before stated had not been taken at that city a moment too soon. On the night of the 30th May the insurrection broke out. At 9 o'clock the evening gun fired as usual. The men of the 71st Regiment, previously told off in parties, started off at the signal to fire the bungalows and murder their officers. A few men only of the other infantry regiments, and some men of the 7th Cavalry joined them.

Sir Henry Lawrence was dining that night at the Residency bungalow at Mariáun. An officer of his staff had informed him that he had been told by a Sepoy that at gun-fire (9 p.m.) the signal to mutiny would be given. The gun fired; but all for the moment seemed quiet. Sir Henry leaned forward and said to the officer, "Your friends are not punctual." The words were scarcely out of his mouth when the discharge of muskets proved that his staff officer had been well informed. The horses were brought up, and Sir Henry followed by his staff started for the lines.

On his way he found 300 men of the 32nd, four guns Major Kaye's battery, and two of the Oudh force, posted in a position on the extreme right of the 71st lines, and contiguous to the road leading from cantonments to the city. Recognizing the necessity of preventing as far as possible communication between the mutineers and the evil-disposed in the city, Sir Henry took with him two guns and a company of the 32nd to occupy the road leading from the cantonment to the bridge. He sent back shortly for the remainder of the Europeans, and for two more guns. Meanwhile, the officers of the native regiments had hastened to the lines to endeavour to reason with the men. Many of those, however, had already begun the work of plunder. A considerable body had marched straight to the 71st mess-house, and failing to find the officers, who had just left, they fired it. Very soon after a musketry fire from the 71st lines opened on the Europeans. These replied with grape, and with such effect that the Sepoys made a rush to the rear. In their hurried

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course they passed the infantry picket, composed of natives, and commanded by Lieut. Grant, 71st Native Infantry. Some of his own men tried to save this officer, but a Sepoy of his own regiment discovered his place of concealment to the mutineers and by these he was brutally murdered. Meanwhile, Lieut. Hardinge, taking with him a few of the Irregular Cavalry, had been patrolling the main street of cantonments to maintain order and to save life and property. He was not, however, in sufficient force to prevent the burning and plundering of the officers' houses and the bazaars. The mutineers were prowling about in all directions. One of them fired at Lieut. Hardinge, and when his shot missed fire he came at him with his bayonet and wounded him in the arm.

During this time there had been great excitement in the lines. Gradually, however, some satisfactory symptoms evinced themselves. First, about 300 of the 13th Native Infantry, with their British officers, their colours, and the regimental treasure, marched up and enrolled themselves with the British. They were followed by a very few of the 71st but without their colours or their treasure. Of the 48th nothing was heard that night. The Europeans still remained formed up in the position assigned to them in case of alarm by Sir Henry Lawrence, their front flanking that of the several native regiments. About 10 p.m. some of the mutineers crept up to and occupied some empty lines bearing on that position, and opened a musketry fire. Brig. Handscomb, riding from his house straight into the 71st lines, was immediately shot. The fire, however, soon ceased, and arrangements having been made to protect the Residency bungalow, and the part of the cantonment next the city road, and strong guards having been posted, the force piled arms and waited for the morn.

At daylight next morning, Sir Henry placed himself at the head of the forces, and learning that the rebels had retired on Múdkipúr followed them thither. Crossing the parade ground the men came upon the body of Cornet Raleigh, a newly-joined officer who, left sick in his quarters, had been murdered by the rebels. Almost at the same time the mutinous regiments were discovered drawn up in line. At this critical time an officer on Lawrence's staff noticed, or thought he noticed, a mutinous disposition on the part of the 7th Cavalry, till then loyal. Their attitude appeared to him to betoken an intention to charge the British guns. To set the matter at rest the officer directed the guns to open fire on the distant line Then the men of the 7th Cavalry with the exception of about 30, raised a yell, and galloped over to join the enemy, who turned and fled with them. Our troops followed them up for about 10 miles and took 60 prisoners. In this pursuit Mr. Gubbins greatly distinguished himself, capturing several of the enemy with his own

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hand. By 10 a.m. our force had returned to cantonments, the heat being excessive.

Sir Henry Lawrence had been on the point of returning to Europe for the benefit of his health before the storm arose, when he was summoned by Lord Canning to Oudh. Regarding that summons as a call of duty, with characteristic forgetfulness of self, he had obeyed it. But under the fatigues, the excitement, the anxiety of his new life, his physical condition had become worse than when his medical advisers had ordered him home from Rajputana.

Sir Henry Lawrence feeling his strength daily failing despatched to Lord Canning, on the 4th May, a telegram, in which he earnestly recommended that in event of anything happening to himself, the office of Chief Commissioner might be conferred upon Major Banks, and the command of the troops on Colonel Inglis. "This," he added, "is no time for punctilio as regards seniority. They are the right men—in fact, the only men—for the places."

Major Banks was the Commissioner of the Lucknow Division. He was the most promising political officer who had not actually attained the highest grade in that branch of the Indian Service. For languages he had a remarkable talent. He was familiar alike with Persian, with Hindí, and with Sanscrit. He had filled several offices with distinction and was esteemed by everyone.

Lieut.-Colonel Inglis (afterwards Major-General Sir J. Inglis, K.C.B.), the other officer referred to, commanded the 32nd Foot. He was in the prime of life, an excellent soldier, active, energetic, and quick-sighted. The native army having mutinied, and the only remaining reliable troops being European, it was practically necessary that the officer commanding the European regiment should have the chief military authority.

Sir Henry Lawrence was particularly desirous to retain the services of a large portion of the native troops. He believed that those who had stood the ordeal of the 30th May would thenceforth remain faithful. He believed that without the aid of native troops his position at Lucknow would not be tenable. He collected all the Sikhs from the three native regiments and formed them into one battalion. He also collected about 170 men who had served in the Company's army prior to the annexation, and placed them under separate command. The number of the native brigade was thus brought up to nearly 800.

On the night of the 9th June the whole of the cavalry of the military police remaining at their headquarters at Lucknow broke into revolt. Capt. Gould Weston at once rode down to their lines, followed only by his two native orderlies. He came upon them as they were starting and exhorted them to listen to the voice of duty and of honour, but his efforts proved unavailing. On the morning

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of the 12th of June the 2nd Regiment of Infantry of the Military Police mutinied at the Motí Mahal about 1½ miles from the Baillie Guard.

Since the mutiny of the 30th May, efforts to make the Residency defensible had been pushed on with extraordinary vigour. The outer tracing had been connected by breastworks; ditches had been excavated in front of them, and parapets erected behind them; at certain points ramparts had been thrown up and embrasures had been pierced; slopes had been scarped; stakes and palisades fixed; some houses had been demolished, the roofs of others had been protected; windows and doors had been barricaded; walls had been loopholed. All the ordnance belonging to the ex-King of Oudh that could be found in the city had been brought within the defences. Some houses outside the walls of the Residency were left solely because time had not remained to level them as had been intended. The omission to destroy them was at a later period much regretted, for they were used by the rebels as shelter houses whence to watch the movements of the garrison and to keep up a heavy fire on the defences.

Nor was the Machchí Bawun neglected. Sir Henry Lawrence had originally resolved to hold this post in conjunction with the Residency, only to concentrate on the latter when threatened in overwhelming force. With this view he had strengthened it and made it habitable for Europeans. He then stored it with food and ammunition. On the 13th of June, Sir Henry was able to write to Lord Canning in the words quoted:—"We hold our ground in cantonment, and daily strengthen both our town positions, bearing in mind that the Residency is to be the final point of concentration." Sir Henry continued to strengthen the Machchí Bawun till the very last, believing that the preparations made would be greatly noised abroad, and would affect the moral of the enemy.

A terrible anxiety which preyed upon Sir Henry Lawrence about this time was caused by his inability to assist Sir Hugh Wheler, then beleaguered in Cawnpore. The cessation of communication with that station on the 6th of June had made it clear that the native troops there had mutinied. That they had gone further and under the leadership of Nana Sahib had besieged the British General in his barracks shortly became known. Writing to Sir Hugh Wheler on the 16th of June, the Chief Commissioner said: "I am very sorry indeed to hear of your condition, and grieve that I cannot help you. I have consulted with the chief officers about you, and except Gubbins, they are unanimous in thinking that with the enemy's command of the river we could not get a single man into your intrenchment. . . . We are strong in our intrenchments; but by attempting the passage of the river, should be sacrificing a large detachment without a prospect of helping you . . . " etc.

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A week later he wrote to Lord Canning: "It is deep grief to me to be unable to help Cawnpore; I would run much risk for Wheler's sake, but an attempt with our means, would only ruin ourselves without helping Cawnpore." No military critic will question the soundness of these views. To cross the Ganges, even with the entire force at the disposal of Sir Henry Lawrence, in the face of the army serving under Nana Sahib, would have been impossible.

A few days later a letter reached Sir Henry with the information that Wheler had agreed to treat with Nana Sahib. He then knew that all was over. His forebodings were confirmed by the receipt of details of the massacre on the 28th June. The following morning the advanced guard of the enemy's force marched on Chinhut, a village on the Fyzabad Road, within 8 miles of the Residency. This gave Sir Henry an opportunity for which he had been longing. With the foresight of a real general opposed to Asiatics, he felt that for him to await an attack would be to invite a general insurrection, whereas an effective blow dealt at the advanced troops of the rebels would paralyze their movements, and spread doubt and hesitation among them. To say that because he did not succeed his plan was bad and impolitic is not a logical argument. His plan was justified alike by military science and by political considerations. Whilst he fought a battle in which victory would have been decisive, he lost little by defeat.

Sir Henry's first step was to withdraw the troops from the cantonments and to bring them within the Residency. He then ordered that a force composed of 300 men of the 32nd Regiment; 230 men of the regular native infantry; the small troop of volunteer cavalry, 36 strong; 120 troopers of the Oudh Irregulars; ten guns and an 8-in. howitzer, should assemble at the iron bridge at daylight the following morning to march at once in the direction of Chinhut.

Of the ten guns, six were manned by natives and four only by Europeans. The howitzer was on a limber drawn by an elephant driven by a native. This work being mainly concerned with the siege operations it is not proposed to give a very long and detailed account of the Battle of Chinhut.

The following is the official report of that action by Brig. Inglis, commanding the Garrison of Lucknow, to the Secretary to the Government Military Department, Calcutta:—

Dated LUCKNOW, *26th September*, 1857.

SIR,—In consequence of the very deeply-to-be-lamented death of Brig.-General Sir H. M. Lawrence, K.C.B., late in command of the Oudh Field Force, the duty of narrating the military events which have occurred at Lucknow since 29th June last, has devolved upon myself.

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On the evening of that day several reports reached Sir Henry Lawrence that the rebel army in no very considerable force, would march from Chinhut (a small village about 8 miles distant on the road to Fyzabad) on Lucknow on the following morning; and the late Brigadier-General therefore determined to make a strong reconnaissance in that direction, with the view, if possible, of meeting the force at a disadvantage, either at its entrance into the suburbs of the city, or at the bridge across the Goterai, which is a small stream intersecting the Fyzabad road, about half-way between Lucknow and Chinhut.

The force destined for this service—the details of which have been given above—moved out at 6 a.m., on the morning of the 30th June.

The troops misled by the reports of wayfarers—who stated that there were very few or no men between Lucknow and Chinhut—proceeded somewhat further than had been originally intended, and suddenly fell in with the enemy, who had up to that time eluded the vigilance of the advance guard by concealing themselves behind a long line of trees in overwhelming numbers. The European force, and the howitzers, with the native infantry held the foe in check for some time, and had the six guns of the Oudh Artillery been faithful, and the Sikh Cavalry shown a better front, the day would have been won in spite of an immense disparity of numbers. But the Oudh artillerymen and drivers were traitors. They overturned the guns into ditches, cut the traces of their horses, and abandoned them, regardless of the remonstrances and exertions of their own officers, and of those of Sir Henry Lawrence's staff, headed by the Brigadier-General in person, who himself drew his sword on these rebels. Every effort to induce them to stand having proved ineffectual, the force exposed to a vastly superior fire of artillery, and completely outflanked on both sides by an overpowering body of infantry and cavalry, which actually got into our rear, was compelled to retire with the loss of three pieces of artillery which fell into the hands of the enemy, in consequence of the rank treachery of the Oudh gunners, and with a very grievous list of killed and wounded. The heat was dreadful, the gun ammunition was expended, and the almost total want of cavalry to protect our rear made our retreat most disastrous.

All the gun ammunition was exhausted in this disastrous action. In this dilemma Sir Henry showed a nerve and decision not to be surpassed. He placed the guns on the bridge and ordered the portfires to be lighted. The feint had all the hoped-for effect. The enemy shrank back from a bridge apparently defended by loaded guns. They at once relaxed their pursuit, and the little army succeeded in gaining the shelter of the city and in retiring in some sort of order on the Machchí Bawun and the Residency. Their losses had been most severe and they had left the howitzer and two

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field pieces behind them.* On arriving at the Residency Sir Henry ordered out 50 men of the 32nd under an officer, Lieut. Edmonstone, to the iron bridge over the Gumtí, with a view to their being posted in the two houses on either side of the bridge, to defend it. Towards this bridge the elated enemy surged in crowds, but they never forced it. The 50 Englishmen covered by a fire from two 18-pounders in the Redan battery, held it successfully though not without loss, till noon. The enemy then desisted, and crossed the river by another bridge. Our men were then finally withdrawn. This defence was a very gallant affair.

The first consequence of the defeat was the occupation of the city by the rebels and the uprising of the discontented spirits within it. That very afternoon they began to loophole many of the houses in the vicinity of and commanding the Machchí Bawun and the Residency. They even succeeded in bringing a 6-pounder to bear on the outer verandah of the post afterwards known as Anderson's post. Subsequently in the same afternoon, they brought another gun into position, and soon demolished the outer defences, including a loopholed mud parapet but recently erected. The post, however, was so important, that orders were sent to the garrison to hold it to the last extremity.

The following morning the enemy opened a heavy fire on the Machchí Bawun and on the Residency. Sir Henry had foreseen this action and had prepared for it. Resolved to concentrate all his defensive efforts on the Residency, he signalled the following night to the garrison of the Machchí Bawun, to evacuate and blow up that fortress. These orders were admirably carried out by Capt. Francis, 13th Native Infantry, then commanding at that post. A quarter of an hour past midnight the garrison of the Machchí Bawun entered the Residency with their guns and treasure without the loss of a man. Shortly afterwards the explosion of 240 barrels of gunpowder, and of 594,000 rounds of ball and gun ammunition announced the destruction of that post.

The garrison, consisting, including civilians, of 927 Europeans, and 765 natives were now concentrated in the Residency. To all appearances the situation was desperate. Not only were the fortifications incomplete, but the enemy had at once occupied and loopholed the houses which had been left standing, outside and close to those fortifications. The west and south faces of the enclosure were practically undefended, the bastion which had been commenced at the angle of the two faces having been left unfinished.

Since the retirement of our force within its lines of defence, the

* These were however spiked by Capt. Wilson, the A.A.-General, before they were left. The heroic efforts made by Lieut. Bonham, of the Artillery, to save the howitzer would most assuredly, had Sir Henry Lawrence lived, gained for that officer the Victoria Cross.

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fire of the enemy upon it had been continuous. Night and day, from the tops of surrounding houses, from loopholed buildings, from every point where cover was available, they had poured in a perpetual fire of round shot, of musketry, and of matchlock balls. Many of the garrison who were in places considered before the siege perfectly safe were hit. But no place was so exposed as the Residency itself, and on it a well-directed fire was constantly maintained. Moreover, the enemy had recourse to digging deep approaches to their batteries and guns, and these effectually concealed them from our sharpshooters. But long before this cautious system of attack had attained its full development, the garrison sustained an irreparable loss.

Sir Henry Lawrence occupied in the Residency a room convenient for the purpose of observing the enemy, but much exposed to their fire. There the day after the defeat at Chinhut, he was seated, conversing with his secretary, Mr. Cooper. Suddenly, an 8-in. shell fired from the very howitzer that we had lost at Chinhut, fell into the room, close to them. It burst, however, without injury to either. The whole of the staff then implored Sir Henry to remove to a less exposed position. But this he declined to do, remarking with a smile that another shell would never be pitched into the same room. Later in the day, when it was evident that the enemy's round shot were being directed at the Residency and were striking the upper storey, Capt. Wilson and Mr. Cooper again pressed Sir Henry to go below, and to allow his things to be moved. He promised to comply on the morrow. The following morning he went out to post and arrange the force which had come in from the Machchí Bawun, and to place the field pieces in position. He returned tired and exhausted about 8 o'clock. He lay down on his bed, and transacted business with the Assistant Adjutant-General, Capt. Wilson. He was engaged in this work when a howitzer shell entered the room, and bursting, wounded him mortally. He lingered in extreme agony till the morning of the 4th when he died.

"Few men," wrote Brig. Inglis when commenting on his death, "have ever possessed to the same extent the power which he enjoyed of winning the hearts of all those with whom he came in contact, and thus ensuring the warmest and most zealous devotion for himself and for the Government which he served." The deep affection with which he was regarded when living survives to the present day. Of no man is the recollection more warmly cherished. He devoted all his energies to the country he served so well. In a word, he was a striking type of that class, not a rare one, of the public servants of England in India, who give themselves without reserve to their country. That Sir Henry Lawrence felt to the last the inner conviction that he had so given himself wholly and without stint, is evidenced by his dying wish that, if any epitaph were placed

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on his tomb, it should be simply this: "Here lies Henry Lawrence, who tried to do his duty."

The credit of the successful defence of the Residency of Lucknow is due in the first place to Sir Henry Lawrence. He alone made it possible to successfully defend it. Three weeks before anyone else dreamed of the chance even of a siege he began to lay in supplies. He caused to be brought into the Residency the treasure from the city and, wherever feasible, from out-stations. He collected there the guns, the mortars, the shot and shell, the small arms, the ammunition, and the grain. He strengthened the fortifications, formed outworks, cleared away the obstructions close up to the Residency. He did all this before the siege commenced.

Sir Henry died on the 4th July. In consequence of his death-bed instructions, Major Banks assumed the chief civil authority, whilst the command of the troops devolved upon Brig. Inglis.

The ground on which were built the detached houses now about to be attacked was an elevated plateau, the surface of which was rough and uneven. The defences traced around it had the form of an irregular pentagon. The accompanying plan will show that regarding the point indicated as "Innes's house" as the northernmost point, its eastern face ran irregularly parallel with the river Gúmti as far as the Baillie Guard. The line from that point to "Anderson's garrison" constituted the south-eastern, and from Anderson's garrison to "Gubbins's battery" the south-western face. The western face comprehended the line between Gubbins's battery and Innes's garrison.

Innes's garrison occupied a long, commodious lower-roomed house, containing several rooms, two good verandahs, and having a flat roof. It was commanded by Lieut. Loughnan, of the 13th Native Infantry, a most gallant officer.

Overlooking this post on the eastern face was the Redan battery, at the apex of the projecting point of high level ground. This battery was armed with two 18-pounders, and a 9-pounder. It was commanded by Lieut. Samuel Lawrence of the 32nd Foot. The line of intrenchments between the Water Gate and the Banqueting Hall, transferred into a hospital, was commanded by Lieut. Langmore of the 71st Native Infantry. It was entirely without shelter.

Passing over the Residency and the Banqueting Hall, we come to the Treasury buildings situated below and to the eastward of the latter, known under the name of the Baillie Guard. This was armed with two 9-pounders and an 8-in. howitzer, commanded by Lieut. Aitken, 13th Native Infantry. Following the outer tracing we come to Fayrer's house* with one 9-pounder, commanded by Capt.

* Named after Surgeon-Major Fayrer, afterwards Surgeon-General Sir Joseph Fayrer, Bart., K.C.S.I.

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Gould-Weston, to the Financial garrison post commanded by Capt. Sanders, 13th Native Infantry; and to Sago's house commanded by Capt. T. T. Boileau, 7th Cavalry. The two last-named buildings were commanded by the Post Office armed with two 18-pounders and a 9-pounder, and whose garrison was under the orders of Lieut. Graydon. Following the line of outer works we arrive at the Judicial post, an extensive upper house, commanded by Capt. Germon, 13th Native Infantry. Next to that, and forming the south-eastern angle of the position, was Anderson's post—a two-storied house surrounded by a wall, with two good verandahs, and intrenched and loopholed. No battery was attached to this post. It was commanded by Capt. R. P. Anderson, 25th Native Infantry.

The Cawnpore battery, constructed of earth and palisades, was the new post. This was armed with an 8-pounder, and two 9-pounders. This was the only post the commandant of which was constantly changed. The reason was that it was so entirely commanded by the enemy's works, that when they concentrated a heavy fire upon it no man could live in it. But neither could the enemy occupy it, for it was entirely commanded by the house behind it. It thus remained to the end a part of our defences. The Thag Gaol, occupied by the boys of the Martinieré College, and commanded by their principal, Mr. Schilling; the Brigade Mess, a high and convenient building, commanded by Colonel Master, 7th Light Cavalry; and the Sikh squares led to Gubbins's post, armed with two 9-pounders, and an 18-pounder, and commanded by Major Apthorp, 41st Native Infantry. Between this post and the Church Garrison were the Bhúsá intrenchments and sheep pens, slenderly manned by the officers and soldiers of the Commissariat Department. The Church Garrison consisted of about a dozen Europeans. The church was stored with grain. Of the garrison within the lines of defence may be mentioned Ommaney's post, connected by a lane with Gubbins's post and supported by the residents of the Begum Kothí, few in number and principally on the staff.

Far from taking that prompt advantage of their victory at Chinhut which a capable general would have seized, the rebel leaders for nearly three weeks did everything but assault these slight defences. They occupied in force the houses which commanded them, they erected batteries, they placed guns in position, they dug trenches to protect their men from our shells, and from the 1st to the 20th July, they kept up a terrific and incessant fire day and night, not less than 8,000 men, and probably a larger number, firing at one time into the defenders' position. Their fire was very effective. The mosques, the houses which from want of time to destroy them had been allowed to stand, the not very remote palaces, afforded them commanding positions.

Their shells penetrated into places before considered absolutely

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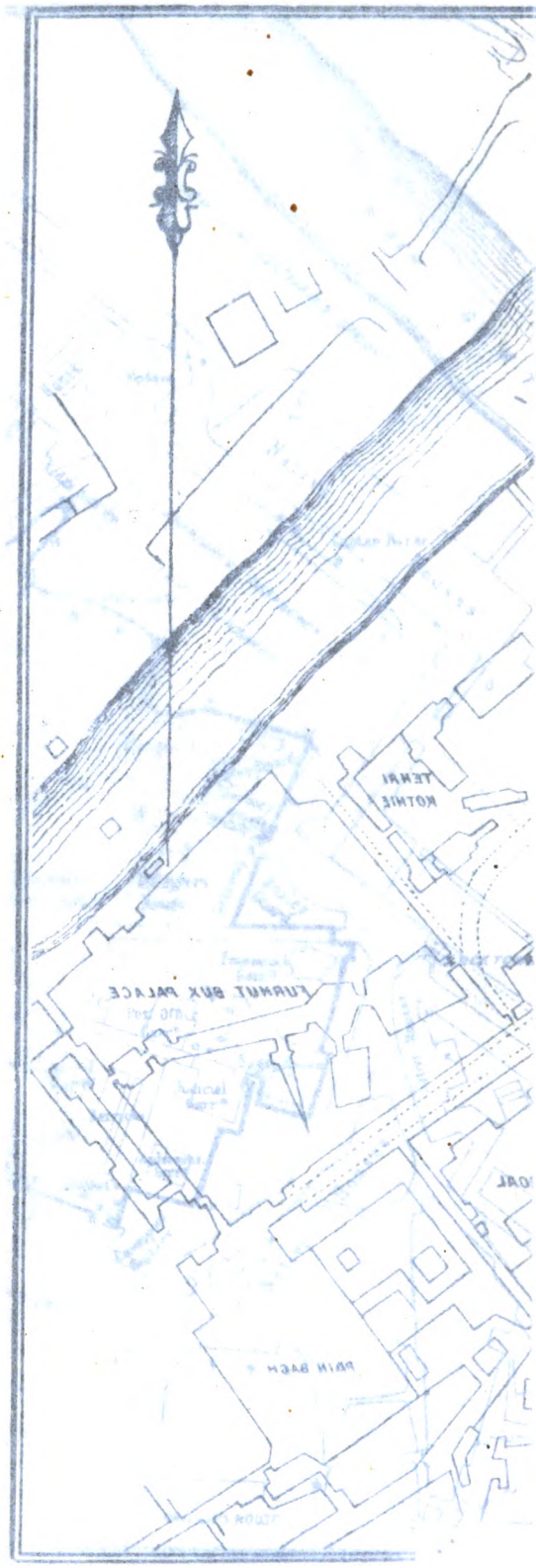

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secure. Many of the garrison succumbed to this incessant rain of projectiles. Mr. Dorin was killed in an inner room of Mr. Gubbins's house, Mr. Dunmaney, of the Civil Service, was mortally wounded on the 4th July, Major Francis, of the 13th Native Infantry, a very gallant officer, on the 7th, Mr. Polehampton, the chaplain, the same day, severely. Before the 20th July, the list of casualties had been increased by Mr. Bryron shot through the head on the 9th, by Lieut. Dashwood, 48th Native Infantry, who succumbed the same day to cholera, by Lieut. Charlton, 32nd Foot, shot through the head on the 13th, by Lieut. Lester mortally wounded on the 14th, by Lieuts. Bryce and O'Brien wounded on the 16th, by Lieut. Harmer wounded, and Lieut. Arthur killed on the 19th. That day Mr. Polehampton, wounded on the 7th, died of cholera. In addition to these officers, many privates, Europeans and natives, succumbed. A few of the latter deserted to the enemy.

Upon the improvised defences the effect of the enemy's fire was even greater. On the 15th Anderson's house was entirely destroyed by round shot, though the post was still nobly held by the garrison; on the 18th many round shots were fired into the Post Office, Fayrer's house, Gubbins's, and the Brigade Mess House. At one time the rebels succeeded in setting the Residency on fire by firing carcasses into it. At another they threatened an assault on Gubbins's post.

A large number of the bullocks perished, and the burying of the animals was no slight addition to the labours of the garrison. The heat during this time was excessive. Cholera was busy. The stench from putrid animals was most offensive. Few officers had a servant. Whilst the days were consumed in fighting, the nights were passed in developing means for the continuance of the struggle. Then stores had to be dug out and carried, guns to be shifted, trenches to be dug, shafts for miners sunk, the dead buried, and the many necessities devolving upon men so situated attended to. Still the garrison showed no sign of faltering.

On the 7th July a sortie was made. The party consisted of 50 men of the 32nd and 20 Sikhs. The object was to examine Johannes' house, a building outside, and close to the line of defence, near the Brigade Mess, as it was believed that the enemy were mining. The sortie was successful. The rebels were driven out of the house, and 15 or 20 of their number were killed. On our side three men were wounded. The daring shown by Lieut. Sam Lawrence on this occasion obtained for him the Victoria Cross.

At midnight on the 20th July, the enemy's fire almost ceased, nor was heavy firing resumed in the early morning. A little after 10 o'clock the rebels sprang a mine inside the Water Gate, about 25 yards from the inner defences, and close to the Redan. Immediately after the explosion they opened a very heavy fire on the defences near which the mine had been sprung. Under cover of

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this fire as soon as the smoke and dust had cleared away, they advanced in heavy masses against the Redan. The garrison, however, received them with so heavy a fire that they reeled back sorely smitten; nor, although they made a second attempt, and penetrated to within a very few yards of the English battery, were they able to effect a lodgment. Again they fell back, baffled.

Simultaneously a heavy column advanced against Innes's house. The garrison here consisted of only 12 men of the 32nd Foot; 12 of the 13th Native Infantry; and a few non-military servants of Government. Against this handful of men the rebels pressed in large numbers, and made their way to within 10 yards of the palisades, and were received with a rolling fire which drove them back. They came, however, again, and again, and again, but always with the same result.

The enemy's attack was not confined to these two points. They made also a desperate and very determined attempt on the Cawnpore Battery. But their leader being stopped by a well-directed bullet, they became disheartened and fell back. Very soon afterwards another detachment advanced with scaling ladders against Anderson's and Germon's posts. But their reception at both was so warm that they retreated, not to renew the attack.

These attacks made in great force and with considerable resolution were defeated by the British with a loss of but 4 killed, and 12 wounded. By sharp experience the garrison had learnt the wisdom of keeping themselves as much as possible under cover.

But the day following this inspiring victory the garrison sustained a loss which it could ill afford. Major Banks, who had succeeded Sir Henry Lawrence as Chief Commissioner, was shot through the head. His fearlessness, his courage, and his sympathy with suffering had endeared him greatly to the garrison. His place was not filled up. The Brigadier then issued an order intimating that the office of Chief Commissioner would be held in abeyance until such time as the Government of India could be communicated with.*

From the 20th of July to the 10th of August the rebels contented themselves mainly with keeping up an unremitting fire upon the garrison, loopholing more houses, and bringing the attack closer and closer. They made no general assault. On their side the defenders were so fully occupied in repairing damages, in countermining, and in replying to the enemy's fire that they could not find sufficient time to remove the carcasses of horses and bullocks. The stench from these carcasses and from others partially buried became almost unbearable, and aided in fomenting the pest of flies, as well as the spread of cholera, of dysentery, of scurvy, and of small-pox. The badness and insufficiency of the food, the want of cooks, and the indifferent cooking, aided greatly the working of these diseases.

* Subsequently entirely approved by the Governor-General.

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But in the midst of these trials a spark of hope of aid from outside glimmered in the horizon. Many letters had been despatched by messengers believed to be faithful, but up to the 25th July no reply had been received to any of them. Early on the morning of the 22nd the pensioner Angad came in from Cawnpore, but without a letter. On this occasion he did not carry one with him for fear of being detained by the enemy; but he stated that the English had been victorious, and that he had seen two European regiments at or near Cawnpore.

At 11 o'clock on the night of the 25th, the same pensioner, who had been sent out again on the night of the 22nd to General Havelock's camp, returned with a reply to that letter from that officer's Quartermaster-General, Lieut.-Colonel Fraser-Tytler. The letter stated that "Havelock was advancing with a force sufficient to bear down all opposition and would arrive in five or six days."

And now the occasional sound of firing on the road between Cawnpore and Lucknow continued to confirm the hopes raised by the opening of this communication in the minds of the garrison.

Four days later, on the 10th August, the rebels made their second assault. About 10 o'clock that morning a body numbering perhaps 1,600 was observed by the garrison massed behind their trenches, opposite the southern face of the defences. Very soon after, a large force was noticed approaching the bridge of boats from the Marián cantonments. The word was passed that an assault was impending. Instantly all the occupants of the posts were on the alert. Half an hour later the enemy fired a shell into the Begum-Kóthí, a building in the centre of the intrenchment. This was apparently a signal, for immediately after they sprang a mine between Johannes' house and the Brigade Mess House. The effect of the explosion was terrible. The greater portion of the Martinieré house was blown in, the palisades and defences, for the space of 30 ft., were destroyed. On the smoke and dust clearing away a breach was discovered through which a regiment might have marched in unbroken order. The enemy advanced with great resolution, occupied Johannes' house and garden and the buildings close to the Cawnpore Battery, and made a desperate effort to take that post. But, whilst they were met by a withering fire from its defenders, the garrison of the Brigade Mess House, composed of a large number of officers, many of them excellent shots, and armed with their sporting guns and rifles, poured upon their flank from its roof a well-directed and continuous fusillade. This front and flank fire quite paralyzed the assailants. Some 30 of their number, however, more daring than their comrades, penetrated into the ditch of the battery within a few feet of our guns.

The following extract from Brig. Inglis' official report dated Lucknow, 26th September, 1857, to the Secretary to Government

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Military Department, Calcutta, relates the events that occurred between the 10th August and the arrival of the relieving force on the 25th September :—

"On the 10th August, the enemy made another assault, having previously sprung a mine close to the Brigade Mess which entirely destroyed our defences for the space of 20 ft., and blew in a great portion of the outside wall of the house occupied by Mr. Schilling's garrison. A few of the enemy came on with the utmost determination but were received with such a withering flank fire of musketry from the officers and men holding the top of the Brigade Mess, that they beat a speedy retreat, leaving the more adventurous of their numbers lying on the crest of the breach. While this operation was going on, another large body advanced on the Cawnpore Battery, and succeeded in locating themselves for a few minutes in the ditch. They were however dislodged by hand grenades. At Capt. Anderson's post they also came boldly forward with scaling ladders, which they placed against the wall; but here, as elsewhere, they were met with the most indomitable resolution, and, the leaders being slain, the rest fled, leaving the ladders, and retreated to their batteries and loopholed defences, from whence they kept up for the rest of the day an unusually heavy cannonade and musketry fire. On the 18th August the enemy sprung another mine in front of the Sikh lines with very fatal effect. Capt. Orr, Lieuts. Mecham and Soppit were blown into the air, but providentially returned to earth with no further injury than a severe shaking. The garrison, however, was not so fortunate. No less than 11 men were buried alive under the ruins, from whence it was impossible to extricate them, owing to the tremendous fire kept up by the enemy from the houses situated not 10 yards in front of the breach. The explosion was followed by a general assault of a less determined nature than the two former efforts, and the enemy were consequently repulsed without much difficulty. But they succeeded under cover of the breach, in establishing themselves in one of the houses in our position, from which they were driven in the evening by the bayonets of H.M.'s 32nd and 84th.

"On the 5th September the enemy made their last serious assault. Having exploded a large mine, a few feet short of the bastion of the 18-pounder gun, in Major Apthorpe's post, they advanced with large heavy scaling ladders, which they placed against the wall, and mounted, thereby gaining for an instant the embrasure of a gun. They were, however, speedily driven back with loss by hand-grenades and musketry. A few minutes subsequently they sprung another mine close to the Brigade Mess, and advanced boldly, but soon the corpses strewn in the garden in front of the post bore testimony to the accuracy of the rifle and musketry fire of the gallant members of that garrison, and the enemy fled ignominiously,

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leaving their leader—a fine-looking old native officer—among the slain. At other posts they made similar attacks, but with less resolution, and everywhere with the same want of success. Their loss upon this day must have been very heavy, as they came on with much determination, and at night they were seen bearing large numbers of their killed and wounded over the bridges in the direction of the cantonments. His Lordship in Council will perceive that the enemy invariably commenced his attacks by the explosion of a mine, a species of offensive warfare, for the exercise of which our position was unfortunately peculiarly situated; and had it not been for the most untiring vigilance on our part in watching and blowing up their mines before they were completed, the assaults would probably have been much more numerous, and might perhaps have ended in the capture of the place. But by countermining in all directions, we succeeded in detecting and destroying no less than four of the enemy's subterraneous advances towards important positions, two of which operations were eminently successful, as on one occasion not less than eight of them were blown into the air, and 20 suffered a similar fate on the second explosion. The labour, however, which devolved upon us in making these countermines in the absence of a body of skilled miners, was very heavy. The Right Honourable the Governor-General in Council will feel that it would be impossible to crowd within the limits of a despatch even the principal events, much more the individual acts of gallantry, which have marked this protracted struggle. But I can conscientiously declare my conviction that few troops have ever undergone greater hardships, exposed as they have been to a never-ceasing musketry fire and cannonade. They have also experienced the alternate vicissitudes of extreme wet and of intense heat, and that too with very insufficient shelter from either, and in many cases without any shelter at all.

"In addition to having had to repel real attacks, they have been exposed night and day to the hardly less harassing false alarms which the enemy have been constantly raising. The insurgents have frequently fired very heavily, sounded the advance and shouted for several hours together, though not a man could be seen, with the view of course of harassing our small and exhausted force, in which object they succeeded, for no post has been strong enough to allow of a portion only of the garrison being prepared in the event of a false attack being turned into a real one. All, therefore, had to stand to their arms and to remain at their posts until the demonstration had ceased; and such attacks were of almost nightly occurrence. The whole of the officers and men have been on duty night and day during the 87 days which the siege has lasted, up to the arrival of Sir J. Outram, G.C.B. In addition to this incessant military duty, the force has been nightly employed in repairing

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defences, in moving guns, in burying dead animals, in conveying ammunition and commissariat stores from one place to another, and in other fatigue duties too numerous and too trivial to enumerate here.

"I feel, however, that any words of mine will fail to convey any adequate idea of what our fatigues and labours have been—labours in which all ranks and classes, civilians, officers, and soldiers, have all borne an equally noble part. All have together descended into the mines, all have together handled the shovel for the interment of the putrid bullock, and all accoutred with musket and bayonet, and relieved each other on sentry without regard to the distinctions of rank, civil or military. Notwithstanding these hardships, the garrison has made no less than five sorties in which they spiked two of the enemy's heaviest guns, and blew up several of the houses from which they had kept up their most incessant fire. Owing to the extreme paucity of our numbers, each man was taught to feel that on his own individual efforts alone depended in no small measure the safety of the entire position.

"This consciousness incited every officer, soldier, and man to defend the post assigned to him with such desperate tenacity, and to fight for the lives which Providence had entrusted to his care with such dauntless determination, that the enemy despite their constant attacks, their heavy mines, their overwhelming numbers, and their incessant fire could never succeed in gaining one single inch of ground within the bounds of the straggling position, which was so feebly fortified that had they once obtained a footing in any of the outposts, the whole place must have inevitably fallen.

"If further proof be wanting of the desperate nature of the struggle which we have, under God's blessing, so long and so successfully waged, I would point to the roofless and ruined houses, to the crumbled walls, to the exploded mines, to the open breaches, to the shattered and disabled guns and defences, and lastly to the long and melancholy list of the brave and devoted men who have fallen.

"These silent witnesses bear sad and solemn testimony to the way in which this feeble position has been defended. During the early part of these vicissitudes, we were left without any information whatever regarding the posture of affairs outside. An occasional spy did indeed come in with the object of inducing our Sepoys and servants to desert; but the intelligence derived from such source was, of course, entirely untrustworthy. We sent our messengers daily, calling for aid and asking for information, none of whom ever returned until the 26th day of the siege, when a pensioner named Angad came back with a letter from General Havelock's camp, informing us that they were advancing with a force sufficient to bear down all opposition, and would be with us in five or six days. A messenger was immediately despatched, requesting that on the

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evening of their arrival on the outskirts of the city two rockets might be sent up, in order that we might take the necessary measures for assisting them while forcing their way in. The sixth day, however, expired and they came not; but for many evenings after officers and men watched for the ascension of the expected rockets, with hopes such as make the heart sick. We knew not then, nor did we know until the 29th August—or 35 days later—that the relieving force after having fought most nobly to effect our deliverance, had been obliged to fall back for reinforcements; and this was the last communication that we received until two days before the arrival of Sir James Outram, on the 25th September.

"Besides heavy visitations of cholera and small-pox, we have also had to contend against a sickness which had almost universally pervaded the garrison. Commencing with a very painful eruption, it has merged into a low fever, combined with diarrhœa; and although few or no men have died from its effects, it leaves behind a weakness and lassitude which in the absence of all material sustenance save coarse beef and still coarser flour, none have been able entirely to get over. The mortality among the women and children, and especially among the latter, from these diseases, and from other causes, has been perhaps, the most painful characteristic of the siege. The want of native servants has also been a source of much privation. Owing to the suddenness with which we were besieged, many of these people who might, perhaps, have proved otherwise faithful to their employers, but who were outside the defences at the time, were altogether excluded. Very many more deserted, and several families were consequently left without the services of a single domestic. Several ladies have had to tend their children, and even to wash their own clothes, as well as to cook their scanty meals entirely unaided. Combined with the absence of servants, the want of proper accommodation has probably been the cause of much of the disease with which we have been afflicted. I cannot refrain from bringing to the prominent notice of His Lordship in Council the patient endurance and the Christian resignation which have been evinced by the women of this garrison. They have animated us by their example. Many, alas, have been made widows, and their children fatherless, in this cruel struggle. But all such seem resigned to the will of Providence, and many among whom may be mentioned the honoured names of Birch, of Polehampton, of Barbor, and of Gall, have, after the manner of Miss Nightingale, constituted themselves the tender and solicitous nurses of the wounded and dying soldiers in the hospital."

General Inglis concludes by bringing to favourable notice the names of those officers who had distinguished themselves, and had afforded him the most valuable assistance during the operations.

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REVIEW.

PAGES D'HISTOIRE, 1914.

(Librairie Militaire Berger-Levrault, Paris: 5, Rue des Beaux-Arts).

THE Librairie Militaire Berger-Levrault has recently issued further numbers of the above series in which the events connected with the present war have been brought down to the end of last year—abstracts from the earlier numbers have appeared in the *R.E. Journal*, February and April.

The 22nd number of the series contains a reproduction of the Serbian Blue Book, 52 despatches are published therein, the first of them dated 29th June, 1914, and the last of them 16th August, 1914 (new style). Many of the above despatches relate to the newspaper campaign against Serbia conducted in Austro-Hungary and Germany after the commission of the Crime of Serajevo and the efforts made by the Foreign Office at Belgrade to combat the charge of complicity in the murder of the Austrian Crown Prince and his consort on the part of official Servia. The despatches disclose that the Serbian ambassador at Vienna warned his Government on the 7th July, 1914 (N.S.), that one thing was clear to him, namely;—With or without proof of complicity on the part of Belgrade in the inspiration of the Crime of Serajevo, the occasion would be seized by the Austro-Hungarian authorities for obtaining the solution desired in Vienna in relation to every question arising out of the alleged Panserb agitation on foot within the limits of the Hapsburg Monarchy. The Serbian Ambassador, in a later despatch dated Vienna, 15th July, 1914, states that, in his opinion, even at the Ballplatz no clear and precise answer could be given, at that date, to a question enquiring as to the nature of the demands which Austro-Hungary proposed to formulate against Servia. He thought, however, that the Dual Monarchy would present a long memorandam detailing all its grievances against Servia in relation to events occurring between April, 1909, and the date of the despatch, and that Servia would be called upon to comply with the demands made in this memorandum without being afforded an opportunity of entering into any discussion into the merits of the question. This forecast proved to be remarkably accurate as will be seen by an examination of the contents of the now famous Austrian Note to Servia, which forms No. 32 of the series in the Serbian Blue Book, and is dated 23rd July. Among the other despatches published are those containing the appeal of Prince Alexander of Servia to the Czar and the latter's reply thereto, Servia's Note of the 25th July, in which the Austrian demands were accepted practically *in toto*, and the announcement addressed on the 25th July by the Austro-Hungarian Ambassador

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at Belgrade to the Serbian Foreign Office that the Ballplatz had decided on a rupture of friendly relations with Servia. In view of what is now known, the penultimate despatch of the series is noteworthy. In it the Serbian diplomatic representative in Berlin reported to his Government that when taking leave of the German Under-Secretary of State for Foreign Affairs, prior to his departure from the Imperial Capital, the latter declared that Germany had always been animated by friendly feelings towards Servia and he therefore regretted that owing to political intrigues friendly relations between Servia and Germany had ceased. The Under-Secretary of State at the same time put the whole blame for the present war on Russia. The final despatch, which is dated Nish, 6th August, contains a report of the late Serbian Ambassador at Vienna to his Government with reference to the experiences of the Serbian Legation and summarizes the situation of affairs in the Dual Monarchy between the 30th June, 1914, and the date of his departure from the Austrian Capital. In this report it is stated that on the 30th June the Serbian Legation at Vienna was put under police supervision, and from this date considerable difficulties were placed in the way of his corresponding with Belgrade by telegraph. Attention is drawn to the fact that many people held the opinion that the German Ambassador in Vienna was largely responsible for the present disturbance of the peace of Europe, and also that a rumour was widely current in the Austrian Capital that a war against Russia had been projected for the spring of 1917, in order to crush her before her most recently authorized military measures could be brought to fruition. The report also states that, according to reliable information, the Wilhelmstrasse did not approve the actions of Austro-Hungary, and that the German Ambassador was considered to have exceeded his instructions. In an annexe to this number is published the statement made by Signor Giollitti in the Italian Chamber on the 5th December, 1914, when he disclosed the fact that Germany and Austria intended aggressive action against Servia in August, 1913, at the time of the Balkan War, and that Germany approached Italy on the subject as a member of the Triple Alliance. Italy pointed out at that time, that this Alliance was formed for defensive purposes alone, and as the measures proposed were essentially aggressive a *casus fœderis* did not exist.

The 23rd number contains the proceedings of the meeting of the Institute of France held in Paris on the 26th October, 1914. In an introduction M. Henri Welschinger reviews in outline the addresses presented to the meeting by some of the *élite* amongst the *savants* and distinguished men of France. The chair at this meeting was taken by M. Paul Emile Appell, of Strassburg. In his address the chairman alluded to the sufferings of Alsace, borne in silence during the past 44 years, under the German yoke. M. Appell contrasted the attitude of Germany with that of her adversary. The former he declared to be a people possessed of a vaulting ambition, holding themselves to be the nation *par excellence*, which was destined to become the Mistress of the Universe, exercising imperious rule over subject nations reduced to a state of abject servility. The latter, he held, had expended her energies to secure liberty and justice ; France had in the past stood

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for the rights of man, and this nation and her young soldiers were now fighting for the rights of humanity.

The address of the chairman was followed by that of M. René Doumic, who speaking in the name of the "Académie Française" dealt with the subject of "The Soldier of 1914." In eloquent terms he drew an appreciative and moving picture of the soldiers who are, at the present time, engaged in the gigantic task of securing the safety and liberty of France, and expressed the gratitude and admiration of their fellow men for all that these soldiers had done, the hardships suffered, and the glorious sacrifices made on the field of battle.

M. Doumic was succeeded by M. Th. Homolle, a delegate of the "Académie des Beaux-Arts," who took for his subject "The Virgins of Acropolis." His thoughts had carried him, as in a dream, to the mutilated statues at Rheims, to that glorious line of kings, martyrs and saints which until recently had adorned the famous cathedral of that city, but had now been reduced to unrecognizable heaps of stones by barbarians. Severe words of denunciation are employed by M. Homolle against the instigators of this work of destruction.

M. Lacour-Gazet, a delegate of the "Académie des Sciences Morales et Politiques," next occupied the attention of the meeting. He selected "The Days of Barfleur and la Hougue" (29th May—3rd June, 1692) for the subject of his address. The incidents dealt with by him relate to an encounter, during the War of the Revolution, between a French fleet commanded by Admiral Tourville, flying his flag on the *Soleil Royal*, and an Anglo-Dutch Squadron under Admirals Russell and Allemande. The various accounts concerning the issue of the fight do not agree; it is, however, admitted that the Allied Squadron was in superior force to its adversary, and also that both sides suffered heavy loss. In some accounts of the encounter it is alleged that the French fleet was dispersed, in other accounts it is claimed that, although the French fleet lost 15 sail of the line, nevertheless it succeeded in putting the Allied Squadron to flight. M. Lacour-Gazet gives a spirited account of the doings of the French fleet in those far distant days; the sailors of our near neighbour and present ally unquestionably fought with great gallantry and well deserved the eulogy of the British Admiral, who congratulated Tourville for the high courage and nerve shown by him in accepting battle in spite of the fact that his fleet was outnumbered in ships.

The eminent lawyer, M. Louis Renault, next addressed the meeting on behalf of the whole Institute. The subject of his address was "The War and International Law in the 20th Century"; it is a very important one at the present time, especially in view of the attitude so recently shown by a nation, ranking amongst the civilized powers of the world, towards treaty obligations. M. Renault deals in his paper with the efforts made during the past 50 years by the Governments in the Old and the New World, aided by public opinion, lawyers and learned societies, to establish some precise code, having the sanction of a treaty, for the regulation of the conduct of belligerents. The subject is introduced with a historical retrospect, covering the period since the date of the Geneva Convention of August, 1864, to that of the Second

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Hague Conference of 1907. It goes without saying that the gross violation by Germany of recognized rules and customs of war, as well as of the provisions contained in the articles of the Conventions to which the German Government has been a party, have proved a serious shock to international lawyers, and they have been profoundly disturbed by the spirit of absolute lawlessness shown.

The proceedings terminated with an address by M. Henri Cordier, a delegate of the "Acadêmie des Inscriptions et Belles-lettres," who dealt with "The Mongul Invasion in the Middle Ages and its Consequences." He recalled the terror with which Western Europe witnessed the arrival on her borders of the savage hordes which wiped out Christianity in this part of the world. France has seen many invasions by savage tribes, and at the present time the Germans, direct descendants of the Teutons and more barbarous than the undisciplined hordes of the 5th century which overran Western Europe, have descended within her northern borders with the determination absolutely to wipe her out. It is for this last reason, says M. Cordier, that nations, which are truly civilized, have risen unitedly to oppose to a modern barbarian a resistance which will not weaken until the power of the invader is utterly destroyed.

The 24th number is in continuation of the 9th and 10th numbers of the series and contains extracts from the *Bulletin des Armées de la République*. Among the articles reproduced is one from the pen of M. Henri Bergson who, under the title "La Force qui s'use et celle qui ne s'use pas" examines the material and moral forces of the belligerents. He expresses the opinion that there is no doubt as to the final issue of the present contest: Germany must ultimately be defeated. All the resources necessary to sustain her fighting powers will eventually fail her, since she developed her material and moral forces to the utmost at the commencement of the war: therefore, once these have been used up, she will not be able to renew them. On the other hand, according to M. Bergson, France is in a happier position; her credit is undisturbed and her seaports open. In consequence, France is still able to import all she requires to replace the wastage of material caused by the war. Again, the spirit to conquer with which her soldiers are so thoroughly imbued is a powerful reserve on the moral side, and furthermore, in her ideals of justice and of liberty, she possesses a something which is not subject to attrition by the wearing processes of war. In another of the extracts M. Henri Lavedan gives a forceful sketch of the now famous Generalissimo of the Allied Forces in the Western theatre of operations. The author expresses the opinion: General Joffre once seen face to face, in the flash of a second, convincing proof is obtained that he is "*prepared*," and not only "prepared" but also "*ready*." The General has inspired his countrymen with illimitable confidence in his powers, and has, at the same time, won their affection by the charm of his manners.

The French official account of the efforts made by the German armies in October and November last to pierce the Allied lines in Flanders, in the attempt made to reach Calais and Boulogne, is also republished in this number, which concludes with an article from the pen of Lieut.-

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Colonel Vesnitch, Serbian diplomatic representative in France, conveying the salutations of the Serbians to the French Army.

The 25th number contains a translation of the German White Book. The despatches which passed between the European capitals during the period immediately prior to the outbreak of war form an appendix to the White Book, and are preceded by a memorandum dated 2nd August, 1914, in which the Imperial Chancellor reviews the events preceding the rupture of friendly relations between the Powers now at war. The memorandum makes reference to the Crime of Serajevo, and then touches upon the formation of the Confederation of Balkan States under Russian protection after the Turkish Revolution of 1908, and the Expulsion of Turkey from the greater part of her former European dominions in 1911. The political ambitions of Servia are examined and it is stated that the situation created by the activities of this little nation was such that it could not be tolerated by Austria. The latter Power, in consequence, communicated information to her northern neighbour regarding the machinations on foot against her, and sought the advice of her ally. The memorandum puts on record the fact that the views of the Wilhelmstrasse coincided with those of the Ballplatz, and, in consequence, assurances were forthcoming that Germany would stand by the Dual Monarchy in whatever action the latter might deem it necessary to take in order to bring Servia to book. The Austrian Note to Servia and its reply are dealt with, the text of both documents being included in the Appendix, together with the observations of the Austrian Foreign Office on the latter. The Imperial Chancellor alleges that Servia commenced to mobilize the day after the Austrian Note was delivered at Belgrade and argues that the attitude of Servia left no other course open to Austria than the declaration of war. The subsequent progress of the diplomatic measures taken by the Powers involved in the present conflict are touched upon; many of the despatches appearing in the diplomatic correspondence relating to the war published by the Entente Powers reappear in the German White Book. The Wilhelmstrasse sum up the foregoing review of the events leading to the present conflagration in the statement: "Thus, it is Russia which has commenced war against us." In the closing paragraphs, reference is made to the fact that on the 31st July last, the German Ambassador at Paris had been directed to ascertain from the French Government whether France would remain neutral in the event of a Russo-German War: 18 hours were to be allowed for a reply. The German Ambassador complied with his instructions at 7 p.m. on the date last mentioned; and at 1.5 p.m. on the following day, he informed the Imperial Chancellor by telegraph that in reply to reiterated requests for an answer to his question, the French Premier had merely replied that France would take whatever steps she deemed necessary in order to protect her interests. The final paragraph of the memorandum declares: "On the following morning, France commenced hostilities."

The 26th number is in continuation of the 18th number of the series and contains the official communiqués relating to the events of the war, etc., issued by the Central Government to the provincial authorities during the month of December, 1914.

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The 27th number is entitled *Germany and the War*. It contains the copy of a letter addressed by M. Emile Boutroux to the editor of the *Revue des Deux Mondes*, and published in the issue of that periodical which appeared on the 15th October, 1914; an extract from the *Petit Parisien*, of the 1st December, 1914, entitled "1870 and 1914"; and a translation of an article headed "French Patriotism and the War" published in the *Daily News* of the 7th December, 1914.

In his letter to the *Revue des Deux Mondes*, M Boutroux, who is a deep student of German philosophy and literature, probes the sources of the doctrines which have permeated into the life of the German nation, and exposes the detestable sophisms which have perverted the soul of that people, so that it has come to pass that a nation which had been admired and beloved by the grandparents of the present generation has now degenerated into a veritable monster whose implacable egoism has led to a most serious disturbance of the peace of the world.

In the extract taken from the *Petit Parisien* attention is drawn to the fact that a marked difference exists between 1870 and 1914; between Bismarck and William II. It is declared that Bismarck was at all times a diplomat of the old type, and was prepared to recognize that there existed in this world great powers other than Germany; that there remained room for other forms of civilization as well as for Teuton culture. The Iron Chancellor had no thought of establishing German hegemony, neither on the seas nor beyond the borders of Europe. In Bismarck's time although the Germans were guilty of acts of brutality, and were also totally wanting in the sense of chivalry, nevertheless they aimed in the war of 1870 rather at the military forces of their adversary than at the civil elements of the nation. The present war differs essentially in its characteristics. The subjects of William II. have got it into their heads that in all things they are a people infinitely superior to all others, in addition to being the most powerful nation on the face of the earth; in consequence, they are entitled to take whatsoever their fancy wills, and to do with what remains that which may seem most profitable in their interests. The comparison of the two epochs is summed up in a sentence: "The war of 1870 was pitiless, the present one is diabolical."

The article reproduced from the *Daily News* discusses the various aspects in which French patriotism has revealed itself at different epochs in the history of the nation. The provocative attitude of Germany in 1905 in relation to Morocco disclosed to the French people that the hostile acts of her powerful neighbour were not mere bluff, but studied conduct persisted in with the object of securing the ends prompted by her ambition, if necessary, by the employment of force of arms. As soon as the true character of the situation was realized, there arose in France a spirit of deep patriotism differing considerably from the patriotism of preceding generations. An abstract or historical patriotism gave place to one which was essentially matter-of-fact and a living inspiration; young men and old accepted the possibility of a war with a calm resolution, courage devoid of brag, and a fervent hope that "la patrie," freed from the humiliation inflicted long years

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ago on her by the Treaty of Frankfort, would again rise up with renewed prestige and reassume her *rôle* of defender of justice and liberty in this world.

The 28th number is entitled *German Madness* and contains three articles. The first of them is headed "The German Appetite" and calls attention to German publications in which the extent of Germany's ambitions in relation to territorial aggrandisement stands revealed.

The second article is headed "The German War" and contains a reproduction in French of a long article contributed to *Politiken*, an important Copenhagen newspaper, and published in its issue of the 16th August last. In this letter a Dane recounts the unanimous sentiments of the German people in relation to the present war. It is stated that ecstasies of delight went up throughout the German Empire on the declaration of war; the latter event unchained a sentiment, long pent up in Teuton breasts, of unbounded self-confidence, admiration for the prowess of the army, and of devotion to the Emperor and the Empire.

The third article consists of an abridged reproduction of one entitled "German Intellectuals," which appeared in the *Excelsior* of the 27th November, 1914. In this article an attempt is made to throw light on the mental attitude of some of those German philosophers whose tenets and views have been disclosed in the public press.

The 29th number contains an account of the proceedings in connection with the reassembly of the French Legislature in Paris on the 22nd December last. In a preface, M. Henri Welschinger describes the significance of this memorable meeting of the French Parliament in the recognized capital of the country after the temporary sojourn of the Government at its provisional headquarters in Bordeaux. References are made to the important pronouncements contained in the speeches on this occasion; and these are printed in a subsequent part of this number *in extenso*. On this occasion, M. Antonin Dubost presided at the meeting of the Senate and M. Paul Deschanel at that of the Chamber of Deputies. These two Presidents opened the proceedings of their respective Houses with speeches, in which each of them rendered eloquent tribute to the memory of the members of the Senate and the Chamber of Deputies who had fallen on the stricken field; and in dealing with the present situation, they succeeded admirably in interpreting the thoughts of the representatives of the nation in well-chosen language which clearly brought out the stern resolve of the nation to see things through to a finish. The speeches were accentuated by frequent acclamations, and eventually resolutions were unanimously passed that the speeches delivered at the Palais Bourbon and the Luxemburg Palace by the Presidents of the Chamber and the Senate on this occasion be posted in public places.

This number concludes with the Press notices—home and foreign—relating to the above proceedings in the Senate and the Chamber.

The 30th number of the series is a diary of the war covering the period 31st July to 31st December, 1914.

W. A. J. O'MEARA.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

60th year. Nos. 1, 2 and 3 (January, February and March, 1915) with Supplement.

No. 1.—January, 1915.

ONE OF THE CAUSES OF THE PRESENT WAR.

Correspondence on the subject of the Franco-German War took place between David Strauss and Ernest Renan in the columns of the *Gazette d'Augsburg* and the *Journal des Débats* during the course of the two eventful years 1870 and 1871, which saw the commencement and cessation of hostilities between Germany and her western neighbour. This correspondence, consisting of four letters, was reproduced recently in the numbers of the *Semaine Littéraire*, published on the 5th, 12th and 19th December, 1914. One of the letters of this series, first published five months after the conclusion of the war of 1870–71, connects the events of that period with those of to-day, and for this reason has been selected for republication in the January number of the *Revue Militaire Suisse* for the current year. Ernest Renan, the writer of the letter in question, belonged to that band of publicists which had counselled Germany to exercise moderation in relation to the nature and extent of the compensation to be demanded from her then recently vanquished adversary. In the letter under review the writer thereof reproaches Germany for the excessive nature of the penalty exacted from her defeated neighbour, and points out that, in the same way that France had cause to regret the course adopted by her in 1792, so also would Germany, at some future date, have cause similarly to rue the severity of the treatment meted out by her to France in 1871. In this letter Renan points out the marked difference between French and German polity; in his view, the former is founded on the rights of nations, whilst the latter rests on the privileges of a caste. He, naturally enough, claims the former to be the superior of the two, and regards the compulsory transfer of the inhabitants of the conquered provinces to the rule of a prince in the choice of whom these people had had no voice, and the imposition of German polity upon them as an unforgivable blunder on the part of the conqueror, and a wrong, moreover, which demanded reparation.

BELGIAN NEUTRALITY AND THE GERMAN INVASION.

The review of a work by Maxime Lecomte and Lieut.-Colonel Camille Levi entitled *Neutralité belge et Invasion allemande*, published by Lavanzelle, of Paris, and Lebègne et Cie, of Brussels, last year, and only a few

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weeks prior to the outbreak of the present war. The work contains prophetic references to the events which took place in Western Europe in August last. The reasons which would prompt Germany to strike at France through Belgian territory are set out, and the measures to meet this German offensive open to the French are examined. The possibility of a double attack on France, that is to say one launched through the gap of the Vosges *viâ* the Grand Duchy of Luxembourg simultaneously with the march of the German armies through Belgium is touched upon; and in the latter case, the question is discussed whether the execution of the main German effort would be assigned to the right or to the left wing of the forces detailed to carry out the attack. The strategic surprise on Germany's side fortunately failed, although she had herself chosen the propitious moment for her aggressive actions in July last. This failure is attributed, in the review, to want of success in effecting a proper combination of the various arms on the field of battle, the method of attack adopted, as also to the neglect of the supreme German Command to ensure numerical superiority at the decisive centre.

An Episode in the Retreat of the French Army of the East on Les Verriéres in 1871.

It will be remembered that in 1871 the French Army of the East had the misfortune to be interned in Switzerland. The story is here told of the experiences of a lieutenant-colonel of artillery who was with the Army of the East, and who had assigned to him the double duty of organizing the defence of the Fort de Joux and of making arrangements for the passage of an enormous convoy through Les Verrières-Suisses as quickly as possible, in order to free the route for combatant troops. Only a few hours were available and restricted facilities alone existed for the performance of the double task. A vivid pen picture is given of the march of the long column of waggons during an intensely cold night through country in which snow was lying deeply on the ground. Although matters appeared to the lieutenant-colonel to be going badly, owing to lack of discipline on the part of the escort, which had apparently disappeared during the hours of darkness, nevetheless, at daybreak, when the general and his staff passed the column, the escort, which had mysteriously reappeared on the scene, showed such extreme alertness as to cause the general to compliment the lieutenant-colonel in highly laudatory terms. The immediate command of the Fort de Joux had been handed over to a captain of the Bridging Train. The lieutenant-colonel had some misgivings as to the latter's capacity; however, when the Prussians appeared on the scene, the captain unexpectedly dealt with the situation in a most creditable manner and covered himself with glory.

A Few Words on the Teeth of our Recruits.

An article from the pen of Dr. Alfred Matthey, Surgeon-Lieutenant, 3rd Regiment of Field Artillery, based on data accumulated from an examination of recruits at various centres in Switzerland.

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NOTES AND NEWS.

United States of America.—A communiqué from a special correspondent of the *Revue*, in which attention is drawn to the strong current of public opinion in the United States in favour of the introduction of a better system for defensive purposes than exists at present. The weak points of the existing system are recapitulated, and a scheme of reorganization is discussed by means of which it is proposed to double the Regular Army ; at the same time, under the scheme 1st and 2nd Reserves would be created and the State Militia quintupled.

Portugal.—Another special correspondent deals with the question of Portugal and the British Alliance ; the advantages of such an alliance are discussed at some length.

This number of the *Revue* concludes with a short bibliography, relating to works of military interest.

No. 2.—February, 1915.

THE GERMAN OFFENSIVE AGAINST FRANCE

(Forecasts of the best known French military writers).

Remarkably accurate forecasts in relation to the present war are contained in the works of several well-known French officers, amongst whom may be specially mentioned Generals Langlois and Maitrot, Colonels Boucher and Mordacq, Capt. Felix and Charles Malo. The pronouncements contained in their works have now proved to be prophetic in their inspiration. Since the annexation of Bosnia-Herzegovina (1909), and the days of the Agadir affair (1911), the views of the authors named above have been reproduced in several French periodicals and have been widely discussed. The *Revue des Deux Mondes* of 15th April, 1913, contained a notable article on the subject from the pen of Commandant Patrice Mahon entitled "Three Years' Service and German Armaments." The author there points out that the forecasts of the best-informed military writers on the strategical relations of France and Germany are based generally on the following considerations :—

(*a*). The traditional German plan of operations, as applied in 1870 ; modifications naturally being necessary to make allowance for the possibility of Russian intervention, the incorporation of Alsace and Lorraine into the German Empire, and the existence of the strong lines of defence created in Eastern France since 1871.

(*b*). The development of the German railway network and the creation of important entraining and detraining centres along the military frontier ; the latter naturally indicate the concentration zones.

The development of the German plan of campaign against her western neighbour can be traced from the first scheme for the invasion of France sketched out by Clausewitz which, with some modifications, was incorporated in the memoir drawn up by Moltke in 1869. The latter's plan of campaign, as is known, was based on a single concentration zone—the Rhenish Palatinate—and the assumption of a vigorous offensive in order that the French should not have time to repair the mischief arising from their numerical inferiority at the point where the first German blow would be struck. It is interesting to note that, in the

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opinion of Von der Golz, if, at the commencement of the present war, France had been able to gain three days on Germany in connection with the mobilization of her army, Metz and Thionville could have been invested by French troops without the necessity of striking a single blow and these troops could then have advanced to the line of the Saar and cut the German communications with Strassburg. Had France been able thus to forestall her adversary, the German armies would have been obliged to effect their preliminary concentration in the same region as that actually selected by Moltke in 1870 for his preliminary concentration.

The writers named above had urged the desirability of providing the French Field Army with guns of large calibre, and had foreseen the possibility of the Germans bringing siege and fortress guns into the field, in order to compensate for the inferiority of the 77-m.m. gun as compared with the now famous French '75' gun. They further prophesied that battles would last long, and might eventually resolve themselves into underground warfare, in which mining would play a large part.

Explosive Bullets used by the Austrians.

Explosive bullets have been found by Serbian soldiers on Austrians taken prisoners during the present war, and ammunition waggons containing explosive bullet cartridges—the so-called "Einschusspatronen"—have also fallen into the hands of the Serbian Army. The above article contains a description of these cartridges, with illustrations, and also a summary of statements made by Austrian prisoners belonging to various units regarding the issue of explosive bullet cartridges to their units. The first issue appears to have been made in September last, when the good shots of certain regiments had from 5 to 30 of these cartridges served out to them. Photographic reproductions of the cartridges, the nature of the wounds inflicted by the bullets in question, and the character of the perforation produced in a plank of wood experimented upon are given.

Notes and News.

Switzerland.—In these notes the question of Swiss neutrality is discussed, and it is stated that both politically and morally Switzerland is, at the present time, in too unsound a position to carry out its obligations as a neutral. The situation appears to have caused perturbations in some quarters and steps have, in consequence, been taken by the Swiss press to educate public opinion on the subject. Two articles, one entitled "The Public Conscience," and the other "A Neutral People but not a Contemptible One," which have appeared recently in the *Gazette de Lausanne*, are referred to. The latter deals with the recent violation of Belgian neutrality, and asks the question as to what course Switzerland should adopt in the event of an attempt being made to violate her neutrality also.

Canada.—A special correspondent of the *Revue* gives an account of the raising of the Canadian Contingent during the autumn of 1914.

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The remarkable nature of the response made to the call to arms in Canada is dealt with, references being also made to the Concentration Camp at Valcartier; the sanitary services; horses; the training of recruits in the use of the new entrenching implement invented by Colonel Sam Hughes; the transportation of the First Contingent to England; and the raising of the Second Contingent.

This number of the *Revue* concludes with a bibliography relating to works of military interest.

No. 3.—March, 1915.

THE PRELIMINARY PHASES OF THE INFANTRY FIGHT

(*Advance in the Zone subject to Search by Artillery Fire*).

The subject is divided into four main heads. The first of these heads contains a brief review of the outlines of the general principles on the subject laid down in the Training Manuals in use in the Swiss, German, French, Austrian, Italian and Japanese Armies. In the case of these armies, the formations in which troops should advance in the zone subject to search by artillery fire are left entirely in the discretion of the responsible commanders; the general directions laid down for the guidance of these commanders remind them that their chief care should be to keep their commands screened from the enemy's view, and to avoid ground likely to be subjected to the enemy's artillery fire. The Japanese attach considerable importance to the maintenance of efficient connection between the several units, and particularly that between the leading units and those in the rear of them.

The second head treats of general principles under two main subheads. The first of these subheads deals with the experience of former wars. Extracts are given from a work by Capt. Soloviev, of the Russian Army—"Impressions of a Company Commander"—in which the author relates his experiences in the Russo-Japanese War. It is stated that at distances between 5 and 3 kilometres from the enemy's position, the Russian infantry had been trained ordinarily to advance in column of route, in column of sections or in échelon: however, in the Manchurian Campaign, at ranges of 3 kilometres and less, the Japanese artillery fire was so accurate and effective that it was found impossible to continue the advance in the formations referred to. It became necessary, in consequence, to make the utmost use of the features of the terrain to screen the troops, which advanced to the attack over the intervening space within the range last mentioned at the double in Indian file, the men being 10 paces apart. Experience showed that troops utilizing this formation suffered less loss than those which advanced in double ranks, even when at a considerable distance from the enemy. In the present war, not only has the use of aeroplanes endowed the artillery with what amounts, for all practical purposes, to curved rays of vision exposing what was formerly unseen ground to view, thus enabling the gunners to obtain every conceivable advantage from the fact that the trajectory of projectiles is a parabolic curve, but the aeroplanes, by using darts and bombs, have themselves become engines of destruction against advancing troops. The second of the subheads referred to

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entitled "Study of the Subject" is further subdivided. In an introductory section thereto, it is pointed out that during the preliminary period of the advance to the attack, where opposing armies on the march come into collision, losses cannot be wholly avoided, and that the two points which continue to exercise the most considerable influence in war are :—

(*a*). The morale of the troops; and therefore a commander should not overlook any measures calculated to create or maintain a superiority in morale on the part of his own troops over those of his opponent at the moment of collision, and

(*b*). The advantages to be derived from surprising an enemy. The progress of aviation has naturally increased the difficulties in this matter which formerly existed.

The next section of this subhead deals with the deployment for attack from the column formation in which troops may be advancing. Attention is drawn to the fact that in the Swiss Training Manual it is strongly recommended that preparatory to deployment for attack (from the deep column formation adopted for the advance) a line of shallow columns should be formed. In the case of the Italian, Japanese and German Armies it is laid down that the preliminary deployment for attack should take place at the halt, whereas in the case of the Swiss Army it is prescribed that this manœuvre should be executed on the march, in order that time may not be lost.

Other sections of this subhead are devoted to the advance across the zone at distances just beyond 3,500 to 4,000 metres from the enemy's position, referred to as the "zone suspecte"; the advance across the zone within 3,500 to 4,000 metres from the enemy's position in the case where the march can be screened, as also in the case where it cannot be screened.

The final section of this subhead deals with the preparations necessary to ensure that the attack shall be delivered simultaneously along the whole line. This desirable result can best be brought about by an efficient organization of the connecting links between the several units to be employed in the attack.

In the third main head the application of the above-mentioned principles to the company and the section is discussed; special attention being drawn to details connected with night marches and marches through wooded country.

In the fourth main head the question of the attack on entrenched positions is dealt with. It is held that in this case rapidity of advance is of secondary importance, and also that it is practically impossible to take an entrenched enemy by surprise.

In conclusion, it is stated that in Germany, France and Italy, a special preliminary phase preceding the delivery of an attack, referred to as the "Marche d'approche," is recognized, involving attention to certain rules. It is claimed that unless these rules are strictly adhered to risk is run of engaging the opponents' infantry with troops whose morale is likely to be lower or, at all events, whose ranks have been reduced to hopeless disorder. On the other hand, adherence to the rules at least affords considerable prospect of the "zone suspecte" being traversed

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without serious inconvenience, and thus the encounter with the enemy's infantry can take place with ranks in good order and with a strong feeling of confidence, both of which are factors of good augury promising victory.

MILITARY TRAINING OF THE YOUTH OF THE UNITED STATES OF AMERICA.

The article deals with the military instruction given in the "State Land Grant Colleges" and the "Agricultural Colleges" established in the United States of America under the Morrill Act of 1862. The institutions taking advantage of the provisions of this Act are grouped in four classes, according to the powers conferred upon them with regard to the grant of degrees or diplomas. The military instruction is given by officers of the Regular Army under the direction of the War Department. The military training of the youth of the great American Republic is still in an embryonic stage; the population of the United States of America is 91 millions, and yet only some 5,000 to 6,000 of the young fellows who leave the Colleges annually are amongst those who have taken advantage of the military instruction referred to.

NOTES AND NEWS.

Switzerland.—The question of neutrality is further discussed in this number; some definite conclusions appear to have been formed on the subject. In an article entitled "The Other Anxiety," which appeared in the *Gazette de Lausanne* of 28th February, 1915, the dangers encountered by the large non-belligerent states were touched upon and the position of small nations in relation to such dangers was examined; particularly the danger of absorption by a state which defeats its adversary very completely. It is stated that confusion still exists in the minds of some Swiss people as to the distinction between neutrality and sovereignty or independence. The position of Switzerland in the event of a war between Austria and Italy is examined in relation to the question of the violation of Swiss territory. It is stated that one power alone—Germany—might consider that advantages of a strategical order were to be derived by the violation of Swiss neutrality.

France.—An occasional correspondent of the *Revue* describes a railway journey recently made by him in France. The war measures to prevent the destruction of the permanent way, etc., and the changed conditions of life in Paris brought about by the war are described. Attention is drawn to the differences in the demeanour of soldiers in the firing line and those doing duty in the Provincial Garrisons containing the reserves of the French Army.

Portugal.—A special correspondent of the *Revue* deals with the collisions between the Portuguese and German troops which took place in Angola in October and December last.

This number concludes with a bibliography of works relating to the war which have been recently published.

SUPPLEMENT.

The *Revue Militaire Suisse* is issuing a Supplement (in parts) entitled "The European War" (being a study of strategical considerations)

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from the pen of Colonel F. Feyler. The first part was issued with the February number of the *Revue* and deals with the opening phases of the present war leading up to the Battle of the Marne; the second part came out with the March number of the *Revue* and contains an account of the Battle of the Marne. The author points out in the Preface to this work that history cannot be written without documentary evidence, and so far as the present war is concerned the communiqués issued are not only brief, but their contents have often been written for purposes other than the communication to the public of precise and accurate details of the events which just now are making history.

The opening chapter is entitled "La Manœuvre Morale"; its contents are arranged in sections under various headings—in the first of them "The Official Communiqués" are dealt with. The difficulties of the newspaper correspondent are referred to, and it is pointed out that whilst in Germany the correspondents attached to Army Headquarters are part of a methodical organization specially created for disseminating information, the paternity of which the government officials do not desire to have fastened upon themselves; on the other hand, in France correspondents are not, as a rule, allowed at the front at all. It is suggested that the contents of the communiqués issued by the belligerents have been edited with a view to create, or maintain in the public mind a favourable opinion on the operations of their own armies, and, therefore, constitute a "manœuvre morale," and this keeps in step with the "manœuvre stratégique." The object sought to be attained is not only the strengthening of the will of the army to conquer and the inspiration of confidence in the army on the part of the public, but also the creation of international opinion in favour of the national cause.

The second section is entitled "Attack on Liège." A critical analysis is made of the announcements made in Germany by Wolff's Bureau, and also officially on the 7th August last. On the date in question, it was claimed that German troops had captured the "*fortress* of Liège." It is shown conclusively that although some German troops had penetrated into the *town* of Liège on this date, nevertheless not one of the Belgian forts had been reduced or captured. As a matter of fact, it was not till the 13th August that the first of the Liége forts fell into German hands. There appears to be little doubt that the General Staff intended deliberately to deceive the German public as to the situation on the Meuse.

The third section is entitled "The First Franco-German Encounters." The author comments on the difference in the tone of the French and German announcements relating to the early engagements of the war. He points out that whilst in the former a discreet reserve has at all times been maintained; on the other hand, in the latter, a spirit of invincibility has shown itself, decisive successes have been claimed for which there has been no warrant, and a studious silence has been maintained in relation to setbacks met by German troops.

The fifth section is entitled "The Defeats of the Allies in August, 1914." The events which took place in Lorraine, and on the banks of the Meuse in August are dealt with in the light of the telegrams from

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French and German sources made public at the time, and these accounts are compared. The author is of opinion that whilst the French telegrams appear to have been framed with a view to give the public an insight into the true nature of the movements of the Allied troops in Belgium and on the German Western frontier; on the other hand, in his view, the German telegrams create an impression that the German authorities have been guilty of exaggeration in the accounts given of the operations in which their troops were engaged.

The second part of the Supplement as already stated deals with "The Battle of the Marne." The account of this battle is given under three subheads; the first of these subheads is entitled "The True Version"; it contains a summarized account of the lines of advance of the German armies, and the positions of the German and French forces during the critical dates—these positions are marked on a sketch map printed with the text. Next follows a subhead entitled "The French Version"; the text of the more important telegrams and communiqués issued from the French Headquarters between the 7th and 11th September are reproduced, and a reference is made to the communiqués issued on the subsequent days—12th to 15th September. The French announcements report the main features of the engagement and the German retreat in language which is restrained and accurate. Finally "The German Version" is given; the German communiqués are carefully analyzed by the author, who points out that language of the same equivocal nature as that employed to announce the progress of events at Liège is also used in connection with the accounts of the Battle of the Marne issued by the authorities. Furthermore, successes are claimed therein which had no existence except in the imagination of the compilers of the communiqués.

Under the next section headed "The German 'Manœuvre Morale' relating to the Battle of the Marne" attention is directed to a broad sheet (reproduced in this number of the *Revue*) entitled "*Schematische* Darstellung der vom grossen Generalstab *Amtlich* bekannt gegebenen Kriegsereignissen" (Diary of Events relating to the War communicated officially by the German Headquarter General Staff). The importance of this document is considerable, as it was intended for use by soldiers at the front for their letters to their friends and relatives; ruled lines have been provided on these sheets for any information which letter writers might desire to add to the printed matter, as well as a prepared space for the address of the addressee.

On one side of this sheet the Western theatre of war is depicted, and on the other the Eastern and Colonial theatres of war; each side also contains a diary of events between the 1st August and 5th November. In the case of the diary relating to events in the Western theatre some 90 German victories are recorded, and not one single defeat in the land campaign is admitted. The map of this theatre is also remarkable for the pictorial version of the German advance. According to the markings on the map the main German advance did not proceed further southwards than the line of the Aisne. A dotted line is shown south of this river, passing approximately through Senlis—Montmirail—Vitry-le-François, and against this line a statement appears stating that it

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represents the limits of the *Advanced Guard Actions* fought by the pursuing German hosts between 9th and 11th September. The information contained on the map is no doubt intended to coincide with the contents of the official telegrams sent out by the German Headquarters between the 14th and 16th September.

This part of the Supplement concludes with a short analysis, under the heading "The Legend of the Marne," of the value of the official documents relating to the battle of that name. The author summarizes therein his views on the subject. In his opinion, the French telegrams record with accuracy the main facts of the war as they have actually occurred—an admission of the defeats in August being clearly discernible—whilst the German accounts are, like those of Napoleon I. concerning his own wars of a century ago, largely legendary. The German communiqués issued at the end of August and beginning of September announced definitely that the enemy's forces had been *destroyed* and that an energetic pursuit was alone necessary to complete their discomfiture. Having once made this announcement in precise terms officially, the authorities now find it impossible to withdraw the same.

W. A. J. O'MEARA.

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